ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Vol. XXVI. No. 30.

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THE MISSISSIPPI RIVER COMMISSION has but $1,000,000 to spend on levees. But Louisiana alone wants $1,750,000 for this purpose, and the three states of Louisiana, Mississippi and Arkansas need about $3,000,000. Instead of this amount their proportion of the present appropriation is $347,000 all told. The levee fund of these states is inadequate to meet the demands upon it, and the people fear trouble during the next flood season.

THE NEW STATE MAPS OF CONNECTICUT are about completed and some of the plates are ready for the printer. These maps will be issued at about 25 cts. each, in two forms, which are described as follows, by Professor W. H. BREWER, Dr. JAMES H. CHAPIN and Hon. JOHN W. BACON, the commissioners:

The first (in sheets) will be on a scale of about a mile to the inch. Each sheet will be about 14 by 18 ins. and will cover about 120 square miles of territory. The sheets are drawn irrespective of town, county or similar lines, and extending a quarter of a degree of latitude and longitude. They are in conformity with those being prepared by the general Government for other states, and will doubtless form, ultimately, a part of a great atlas of the whole country.

Twenty of these sheets fall entirely within this state; and 14 others, along the borders, will overlap into the adjoining states, making 34 sheets in all. They are intended to so fit each other at the edges that any two or more adjoining sheets may be mounted together should the convenience of the user demand it. But all mounted as one wall map for the whole state, would make a map about nine feet long, which is too large for convenient use.

Therefore a wall map will be prepared on about half that scale, with all the roads, town lines and similar features, but the elevations and natural contour of the and will be in less detail.

THE ST. JOHNS RIVER JETTY, Florida, is now built out 7,147 ft. on the south side, and of this 1,740 ft. are completed and 4,680 ft. are up to mean low-water mark. The north jetty is 10,165 ft. long, with 353 ft. completed and 6,514 ft. up to low water mark. There is little change outside of the jetties. The inner 12-ft. contour has moved seaward 2,100 ft. in the year and the outer 12 ft. contour has also moved seaward very rapidly, but the distance between these contours is now 700 ft., where it was 2,600 ft. in 1890. The outer 18-ft. contour has moved seaward 800 ft. in the year. The depth in the new channel is now 10 ft. at mean low water, where it was 4½ ft. in 1890.

IN NEW YORK HARBOR, Col. G. L. GILLESPIE, U. S. Engineers, says that the Joseph Edwards Dredging Co. has removed 1,008,097 cu. yds. from the main ship channel. When this project is completed the main ship channel, from the Narrows to the sea, will have a width of 1,000 ft. and a depth of 30 ft., permitting the entrance of the largest vessels at all stages of the tide. But Col. GILLESPIE remarks in his report that unforeseen shoaling is likely to occur at any time, and he recommends that a suction dredge be secured and operated by hired labor, and kept constantly at work at any points requiring its service. The Buttermilk Channel, between Brooklyn and Governor's Island, will soon be 1,000 ft. wide. It is proposed to carry Bay Ridge Channel, in Gowanus Bay, southward with a width of 200 ft. and a depth of 21 ft. There are still many rocks and reefs in the East River and about Hell Gate. The 18-ft. channel at Flood Rock has not been deepened, and there still remains a section of that rock, 100 × 100 ft., above low water.

THE MEIGS ELEVATED-RAILWAY SYSTEM, whose backers have many times seemed to be very near success in getting into operation, is to be put into use between Haverhill and Lawrence, Mass., if the necessary capital can be secured. The road will be about 6 miles in length. Just how the expenditure for an elevated road in this locality is justifiable or is likely to be profitable does not appear. A surface electric road could of course be built for a small part of the cost. It is proposed, however, to obtain a speed of 40 miles per hour on the Meigs road.

THE FIRST THROUGH SHIPMENT OF GRAIN from the Great Lakes to a foreign port without breaking bulk has just been successfully accomplished. A steel steamer built on the Lakes left Duluth about the end of June with a cargo of 95,000 bushels of grain, sailed down the Lakes, the Canadian canals and the St. Lawrence, and arrived in Liverpool July 21.

THE WORST ACCIDENT of the week occurred on a logging railway in El Dorado Co., Cal., July 18. A train was derailed, killing 3 men and severely injuring 3.——An accident on the Chicago & Erie near Hepburn, Ohio, on July 17, in which 9 men were reported killed, proved to be a less serious affair than was stated. A collision occurred between a dressed-beef express composed of Swift's refrigerator cars and a work train pulling into a siding. An engine and 7 cars were smashed, but no one was injured. This occurrence following so closely after the Ravenna collision emphasizes the need for air brakes on fast freight trains.——The number of deaths from the Aspen Junction collision, reported last week, has reached 10. The Coroner's Jury has censured the conductor and brakeman under whose orders the light engine was being moved.——An accident due to a misplaced switch is reported from England on the Manchester Ship Canal work, July 18. A work train ran over an enbankment and struck a party of men at work below.

THE FALSE WORK for a new bridge on the Pittsburgh, Cincinnati & St. Louis R. R., 6 miles below Pittsburgh, was washed away by a sudden flood July 18, and 3 men were drowned.

A LARGE GASOMETER EXPLODED at Rochester, N. Y., July 14. It had been unused for some time and was supposed to be empty of gas. Some had probably accumulated in the upper part, however, and when a light was lowered into it by a watchman the structure was blown to pieces.

AMONG STREETCAR ACCIDENTS for the current week are two in which an electric car was set on fire by the current, one at Bangor, Me., and the other at Atlantic City, N. J.

THE INCREASE IN ACCIDENTS ON STREET RAILWAY LINES was discussed editorially in our issue of July 11. Since that date the following accidents on street railways occurring in that week have been brought to our attention: On July 7 a grade crossing collision occurred in Pittsburg between two electric cars. One of the cars containing 17 passengers was knocked some distance from the crossing and thrown on its side. Three passengers were seriously injured, one fatally. On July 8, at Paducah, Ky., an electric car ran over and killed a boy. On July 9 another accident occurred in Pittsburg, a cable car running over and killing a child. This record makes no pretense of being complete, and covers probably but a small percentage of the total serious accidents on street railways which occurred on the dates named throughout the country.

THE DIAMOND SHOAL CAISSON was lost in a storm off Hatteras, as intimated in our last issue, and it is beyond recovery. Mr. ANDERSON, of Anderson & Barr, the contractors for this caisson, gives the following particulars: The caisson was 50. ft. high and 54 ft. in diameter, with four 9-ft. dredging tubes inside. It was successfully towed from Norfolk, Va. and reached the shoal, 9 miles out from Cape Hatteras, on July 1, and 3 vessels loaded with cement, etc., for concrete were achored near by. The sea was unusually quiet and favorable and the caisson was easily located and dropped to the bottom in water from 22 to 25 ft. deep. It was about three feet out of level, but was righted in a few hours by dredging. But the eddies and currents were so strong that next morning it was 9 ft. out of level again, and the sand was washed away so rapidly by the strong bottom currents that in a few days the caisson had sunk so as to leave only 6 ft. above the water. The caisson could not be built up fast enough to meet this settlement, and the support expected from the shoal was not there, and on July 4 the caisson was abandoned on account of rough weather and the boats were withdrawn. The chief cause of trouble lay in the charts made by the government in 1871. These showed 8 to 12 ft. of water on the shoal. Since that date the shoal had changed as above outlined, and it is shifting rapidly still. Mr. ANDERSON said that the caisson was handled with ease; but that he now proposes to seek authority to construct a riprap breakwater at another point near by to break the force of the waves, and then sink a caisson of greater base and longer to start with. All the machinery for dredging was swept away in the storm and several feet of the top of the tube were broken off by the force of the waves. No attempt will be made to recover the old caisson.

THE gross and net earnings of railways for the month of May, as compared with those for the same period of 1890, are as follows, according to the *Financial Chronicle*:

	May (131 roads).	
	1891.	1890.
Gross earnings	$53,440,399	$55,343,271
Operating expenses	36,656,515	37,952,605
Net earnings	$16,783,884	$17,390,605

This is a decrease of 3.44% in gross and 3.49% in net earnings. The coal companies and the Northwestern and Eastern and Middle roads are the only ones which show gains. The remaining five groups of roads exhibit decreases varying from 18.3% to 0.48%.

AN IRON AND STEEL PLANT is to be erected at Buffalo, N. Y., consisting of a large blast furnace of 200 to 250 tons daily capacity, with open-hearth furnaces and a rolling mill for structural steel. The plant is located on the lake shore, so that ore can be transferred from the boats directly to the stockhouse by a Bleichert cable tramway. The stock hoist for the furnace will be an incline worked by cable, up which 4-ton cars will be run. Mr. FRANK B. BAIRD is General Manager of the enterprise, and the engineer for the construction of the blast furnace is Mr JULIAN KENNEDY, of Pittsburg. An inclined stock hoist at the Thomas furnaces in Alabama was illustrated in our issue of Feb. 28.

THE CATARACT CONSTRUCTION CO., at Niagara Falls, has adopted plans for the canal or raceway to bring water from the river to the water wheels, and also plans for four shafts to be used for wheel pits. The canal will have an area equal to the full capacity of the tunnel. In each wheel pit will be placed four turbines of 250 HP. each under a head of 120 ft., with draft tubes attached, increasing the available head to 140 ft. A Chicago company that has leased 3,000 HP. for a large paper mill is to put in its own raceway and wheel pit, and will commence this work about Aug. 1.

The Production of Phosphate of Lime.

III.

(*Concluded from page 50.*)

THE PHOSPHATE DEPOSITS OF FLORIDA.

The existence of deposits of phosphate of lime in the Florida peninsula of great commercial value has become generally known only within the past two years. The valuable monograph of Dr. PENROSE, from which we have quoted at length in previous articles, was published in 1888, and devotes only a page to the Florida deposits, as follows:

Phosphate deposits have been found in various places in Florida, but as far as is yet known they are either of too small extent or of too poor quality to pay for mining. The only deposit which covers more than a few acres is found in Alachua county, near the central part of the state. The phosphate found here belongs to the subdivision of phosphatic conglomerates. The rock consists of small pebbles, from the size of a mustard seed to that of a pea, closely packed in a matrix of indurated calcareous marl.

This conglomerate occurs in masses weighing from one to twenty pounds. The largest mass yet found was 18 ins. long, 14 wide and 4 thick. The pebbles occur in a bed covering about ten acres and are associated with pieces of a porous limestone rock very common in the region. The bed varies from a fraction of a foot to five feet in thickness. Sometimes it crops out at the surface, and at others it is found at a depth of four or more feet. At Gainesville, a town 19 miles west of this bed, a similar rock is said to have been found in boring an artesian well at a depth of 218 ft.

The masses of rock are not nodules, but seem to] be simply broken fragments. They are much weathered and rounded and are buried in sand.

In some places the pebbles, rounded bones and coral fragments occur loose in a calcareous matrix, as if weathered out of the original conglomerate. Samples of pebbles from this loose material are said by one of the owners of this place (Dr. SIMMONS) to average 85% phosphate of lime, while the whole mass of the rock, as analyzed by C. U. SHEPARD, Jr., averages about 48%.

On the northwest side of this bed runs a stream known as Lochloosa Creek, beyond which is a ridge rising sixty to seventy-five feet above the creek, and called Rocky Hill. The hill is overlaid almost entirely by a deposit of calcareous stones and pebbles imbedded in sand, which sometimes entirely runs out, and again reaches a depth of over six feet. Below is a soft, porous, calcareous rock which is of a spongy consistency and hardens on exposure to air. It is quarried for building the chimneys and foundations of houses. In one of the quarries examined this formation gradually blended, at a depth of three to four feet, into a massive and compact phosphate rock, which is similar in appearance to the phosphatic fragments in the bed described above, except that it is in a solid mass, and is probably the ledge whence the fragments were derived. The surface of the spongy, calcareous rock is very uneven and has been much eroded. It seems as if Rocky Hill, when submerged, was much worn before the pebbles and the sand were deposited on top of it.

It thus appears that although the actual exploitation of the Florida phosphate deposits is recent, experts have for some time known that deposits existed there. Dr. N. A. PRATT, whose part in developing the South Carolina phosphate deposits was narrated last week, is said to have asserted more than twenty years ago in a published pamphlet that the same natural agencies which formed the South Carolina deposits should have formed deposits also on the Florida peninsula.

The credit for the actual discovery of phosphate beds in Florida of commercial value, however, seems to be awarded to a civil engineer, Mr. J. FRANCIS LE BARON, Assistant Engineer of the United States Engineer Corps.

In 1881, while Mr. LE BARON was making surveys for a canal from the head waters of the St. Johns River to Charlotte Harbor, on the west coast of the Florida peninsula, he discovered rich beds of phosphate nodules in the Peace River. The capitalists whom Mr. LE BARON endeavored to interest in his discovery, however, did not appreciate its importance, and for seven years no attempt was made to develop the deposits. In 1888, however, a Mr. T. S. MOORHEAD, of Pennsylvania, began working the Peace River deposits, and in May of that year made the first shipment of Florida phosphate rock. At about the same time, we believe, Dr. N. P. PRATT, a son of the discoverer of the South Carolina phosphates, examined the Peace River deposits in behalf of Mr. GEO. W. SCOTT, of Atlanta, and on the strength of his explorations large tracts of land on the banks of the Peace River were purchased.

This was the beginning of the phosphate boom which raged through 1889 and 1890, and in which fortunes were made and lost as they have been made and lost over every other newly discovered deposit of mineral wealth. The most marvelous stories of the richness of these deposits have been in circulation. One of the most attractive of these was that concerning the richness of the soft land-rock, which was said to resemble soft clay, to be easily dug out with a spade, and to be nearly pure phosphate of lime. Deposits of this valuable material were said to be forty or fifty feet in thickness, and of unknown extent. That there was a certain amount of truth to base these stories upon is apparent from the statement of Dr. PENROSE, quoted above. As will be seen further on, this soft phosphate rock does exist; but, unfortunately, the percentage of iron and alumina which it contains is so large as to make it at present commercially valueless. The following notes on the geology of the Florida phosphates are taken from an article by Prof. N. H. DARTON, of the United States Geological Survey, in the *American Journal of Science*:

The phosphate regions of Florida occur mainly in the western and west central portions of the peninsula, comprising a series of irregular areas scattered at varying intervals along a narrow belt extending from near Tallahassee toward Gainesville, and thence nearly to Charlotte Harbor, a distance of 250 miles. The entire region is not yet fully explored, but the vast extent of the deposits is satisfactorily established, and it is safe to predict that Florida will finally become a prominent source of phosphate. The deposits are exceedingly irregular in extent and richness, and while there are many areas underlaid by large bodies of high grade mineral, the great number of the deposits consist of impure, thin or scattered beds of no economic value.

The phosphates are readily separable into three classes: 1. Rock phosphate, a homogeneous, more or less completely lithified, light-colored phosphate of lime, constituting the surface of the middle Tertiary limestone formation. 2. Conglomerate, consisting of pebbles of phosphate rock imbedded more or less thickly in a matrix of phosphate sand, marl and arenaceous and argillaceous materials. This fragmental formation lies in great sheets on the surface of the limestone, in some cases overlapping the edge of the rock phosphates from which its pebbles were derived. 3. River drift, consisting of phosphate pebbles derived both from the rock phosphate and the conglomerate, and constituting great placer deposits in the stream beds draining the other phosphate regions.

So far as is known, the occurrence of the rock phosphate is restricted to a narrow, irregular belt extending through eastern Citrus County, northward through western Marion, probably to the exposures near Albion, and thence with more or less continuity through Trenton in Alachua, Steinhatchee in Lafayette and Lauraville in Sewanee, possibly to Monticello in Jefferson, Perry in Taylor, and some other reported localities in the same direction. This region is not by any means underlaid by a continuous sheet of phosphate, but includes irregular masses of variable sizes and thickness scattered about in detached bodies often widely separated by barren limestone areas.

At Dunellon, in western Marion Co., there are representative exposures in the extensive mine openings that are now being worked. Here the phosphate was found outcropping at a number of points in the woods, and in low bluffs and reefs in the Withlacoochee River near by. The deposit appears to constitute a large basin, of which the bottom was not reached in a 30-ft. pit in the center. The phosphate is in large part a mixture of chalky and flinty rock similar in texture and structure to spongy limonite, but usually creamy white, gray or bluish gray in color. Some portions consist of dense, homogeneous, lithified materials; others are spongy, stalactitic or laminated. A fair average sample of high-grade mineral was found to contain 83% of phosphate of lime and 4½% of carbonate of lime.

The conglomerate phosphates occupy a very considerable area in Florida, and although not as rich in phosphate of lime as the phosphate rock, they will be of commercial importance. The principal deposits now known are south of the southern termination of the rock-phosphate belt, in the western part of Polk County, in the vicinities of Bartow and Fort Meade, where they constitute sheets of wide area overlying the limestone, sometimes to a thickness of from 20 to 30 ft. These conglomerate phosphates consist of small pebbles of 80% to 85% of phosphate rock, usually light colored, imbedded in a soft chalky matrix of phosphate sand, carbonate of lime, clay and sand in variable proportions. High-grade conglomerate will average from 73% to 78% of phosphate of lime.

MINE AND STOREHOUSES OF THE DUNNELLON PHOSPHATE CO.

PHOSPHATE MINERS AT WORK.

At intervals along the eastern border of the rock-phosphate region, and overlapping it at some points, there are fragmental and conglomerate deposits of considerable extent, but they are much more diverse in composition than the great sheets in Polk County. At the Dunellon mine, northern opening, there is a deposit of this class, and the porous, pebbly sandrock—"chimney rock" of the Gainesville region—appears to belong to the same formation.

The river-drift deposits of phosphates are of great economic importance, for they are rich in phosphate and can be mined at small expense. Nearly every little water course in the phosphate regions contains accumulations of phosphate pebbles, and along the larger streams there are many thick and extensive pebble deposits. Peace Creek drains the Bartow-Fort Meade conglomerate region, and flows over many great placer deposits, some of which are now extensively worked in De Soto County. The Withlacoochee, near Dunellon, and Alifia Creek, northeast of Bartow, also contain extensive accumulations of pebbles. These deposits consist of rock-phosphate pebbles usually from an inch to one-quarter inch in diameter, mixed with more or less sand, and usually with bone fragments and occasional flint pebbles from the limestones.

The three geologic formations to which the phosphates belong are distinctly separate stratigraphically and represent a long interval of geologic time. The rock phosphates appear to be the deeply eroded remnants of the phosphatized surface of the middle Tertiary limestone; the conglomerate deposits overlie these limestones unconformably, and in the Gainesville region, at least, appear to be Miocene in age, and the river-drift deposits are apparently entirely subsequent to the great mantle of Pleistocene white and gray sands which covers the entire peninsula to a greater or less depth.

Excepting in its light color the rock phosphate is a physical counterpart of the brown limonite iron ores of the Appalachian limestone valleys, and the deposits have very similar structural relations. I have found at a number of localities that the massive phosphate graduates into the limestone usually by short transitions, and many areas were discovered in the phosphate belt and under the conglomerate in the Bartow region where the limestone is only partially phosphatized.

The origin of the phosphate of lime is not definitely known, but it seems exceedingly probable that guano was the original source and the genesis of the deposits similar to that of the phosphates on some of the West Indies. Two processes of deposition have taken place, one the more or less complete replacement of the carbonate of lime by phosphate of lime, and the other a general stalactitic coating on the massive phosphates, its cavities, etc.

The apparent restriction of the rock-phosphate deposits to the western "ridge" of Florida may have some special bearing on their genesis, but at present no definite relationship is perceived. The aggregate amount of phosphate rock distributed in fragmentary condition in the various subsequent formations is very great, greater by far than the amount remaining in its original position, and it is possible that the area at one time included the greater part, if not all, of the higher portions of the peninsula. As this region apparently constituted a long, narrow peninsula or archipelago, during early Miocene times, it is a reasonable tentative hypothesis that during this period guanos were deposited from which was derived the material for the phosphatization of the limestone, either at the same time or soon after.

The pebbles of the conglomerate phosphate were undoubtedly derived from the rock phosphates, for they are identical in appearance and composition and overlap them as a shore deposit.

Dr. FRANCIS WYATT, from whose articles in the *Scientific American* we have before quoted, has spent a large part of the time during the past two years in Florida examining deposits in every county on the Gulf of Mexico, as expert chemist and mining engineer. His testimony as to the geology of the Florida deposits and their commercial value is therefore of special interest. We abstract his article as follows:

The Florida deposits of phosphate consist essentially of: 1. Original pockets or cavities in the limestone filled with hard and soft rock phosphates and *débris*. 2. Mounds or beaches, rolled up on the elevated points, and chiefly consisting of huge bowlders of phosphate rock. 3. Drift or disintegrated rock, covering immense areas, chiefly in Polk and De Soto counties, and underlying Peace River and its tributaries.

At the present time the work of exploration or prospecting may be said to have extended all over the state in each of these varieties of the formation. Actual exploitation on the large scale by regular mining and hydraulic methods has been commenced at various points.

In one of the mines, in Marion County, for example, there is an immense deposit of phosphatic material, proved, by actual experimental work, to extend over an area of several acres. It has shown itself to be a combination of the "original pocket" and the "mound" formation, and the superincumbent material, principally sand and marls, has an average depth of about 10 ft. The phosphate immediately underlies it, sometimes in the form of enormous bowlders of hard rock cemented together with clay, sometimes in that of a white, plastic or friable substance resembling kaolin, and probably produced by the natural disintegration of the hard rock by rolling, attrition or concussion. The actual thickness of the entire bed is still somewhat uncertain, but the depth of the quarries is not more than 50 ft., and yet a little over two acres of the land have already yielded more than 20,000 tons of good ore without signs of exhaustion.

Directly outside the limits of these quarries the "pocket" and "mound" formations seem to abruptly terminate, and the deposit assumes, over a wide area, the form of an unimportant drift, which sometimes crops out at the surface, and which has been followed in all directions over the immediate vicinity without leading to another pocket of similar value.

Identical geological phenomena being prevalent in nearly every section of the country, I consider myself warranted in declaring that the Florida land phosphates of high grade occur in beds of an essentially pockety, extremely capricious, uneven and deceptive nature. Some times the pockets will develop into enormous quarries and will probably yield fabulous quantities of various merchantable qualities. At other times they will be entirely superficial, or will contain the phosphate in such a mixed condition as to render profitable exploitation impossible.

This capriciousness or uncertainty will be somewhat less in the case of the "pebble" or drift deposits, since they have been proved to exist at various depths and in varying thicknesses with comparative regularity over a very extensive area. The actual chief working center for this variety is Peace River, which rises in the high lake lands of Polk County and flows rapidly southward into the Gulf of Mexico. Its course is extremely irregular and its bottom is a constant succession of shallows and deep basins. Lakes Tsala, Opopka and Chillocohatchee, and Paines and Whidden creeks are its chief tributaries and the main sources of its phosphate deposits, the pebbles being washed out from their banks and borne along their beds by the torrential summer rains.

The pebbles, when freed from impurities and dried, are of a dark blue color, and are hard and smooth, varying in size from that of a grain of rice to about one inch in diameter. Their origin is proved by the microscope to be entirely organic, and they are intimately mixed up with the bones and teeth of numerous extinct species of animals, birds and fish.

These river deposits all proceed from the banks of sand and *débris* to which I have alluded as "drift," and which are situated on the higher lands in Polk County. Lakeland and Bartow may be taken as the central points of the dried-out deposits, the pebbles being of the same size, but of a lighter color. They are imbedded in a matrix of sand and clay, in which they form the proportion of about 20% in weight of the mass. The thickness of the deposit is exceedingly uneven; in some places it reaches 20 ft. while in others it dwindles down to a few inches.

As would be expected in this species of formation, the chemical composition of Florida phosphate is far from regular. In some regions perfectly white, in others blue, yellow or brown, it is in many instances practically free from iron and alumina, while at others it is heavily loaded with these commercially objectionable constituents. A large proportion of the land rock is very soft when damp, but becomes so hard when dried that it has long being used by the natives, ignorant of its other values, as a foundation or building stone.

The following averages are selected with care from the results of several hundreds of complete analyses made either by myself or by my assistants in Florida and New York. The samples in every case were taken from the exploratory pits in all the different counties and marked before leaving the ground with full details of their origin

They have been classed as boulders of hard rock phosphate, or cleaned, high grade material; boulders and *débris*, or unselected material, merely freed from dirt; soft white phosphate, in which no boulders are found; pebble phosphate from Peace River, as sent to market; pebble phosphate from Polk County drift beds, washed and screened.

	Phosphate of lime.	Oxides of iron and alumina.	Silica and silicates.	Carbonic acid.
Boulders (carefully selected, 120 samples).....	80.49	2.25	4.20	2.10
Boulders and *débris* (237 samples).....	74.90	4.19	9.25	1.90
Soft white phosphate (148 samples).....	65.15	9.20	5.47	4.27
Pebble from Peace River (84 samples).....	61.75	2.90	14.20	3.60
Pebble from drift beds, Polk Co. (92 samples)....	67.25	3.00	10.40	1.70

The point of most importance in the working of Florida phosphates, especially of the land deposits, will be the careful selection, by conscientious and capable superintendents, of the different qualities at the quarries. There being no present market for the highest grade in this country, it will have to be shipped to Europe. The rock will, therefore, require to be crushed to a uniform size to facilitate sampling, and then well washed and thoroughly dried, in order that all the iron and alumina so indiscriminately and unequally mixed up with it in the form of clay may be practically eliminated before shipment.

The maximum limit as accepted by European buyers is 3%; and nothing but experience in actual work, daily guided and controlled by the results of chemical analysis, can be relied upon to keep the material within these bounds. Even the most accomplished expert who examines the beds for the first time, and without a full knowledge of the variability of their composition in regard to this iron and alumina, would be sure to go wrong and commit the most fatal blunders.

There can be no doubt that Florida is the theater of a big "boom," and that it is passing through a critical period of its history. Fertilizer manufacturers from all over the world are hurrying toward its sandy plains, in the hope of acquiring its phosphatic treasures. They find these scattered in all directions, as well in the rivers as in the lands, and so embarrassingly variable in grade that they are brought to a halt by the questions: Where are the "bonanzas"? How are they to be found?

My own opinion of her phosphate mining, as will have been gathered from my remarks, is that it will prove extremely profitable to those who purchase and work its field with judgment, but that it will certainly turn out in the highest degree disastrous to such as allow themselves to be led away by excited first impressions. The interior is still practically unsettled, and traveling is attended by the greatest difficulties and inconveniences. The negro labor is far from plentiful; there are few wagon roads suitable for transportation purposes; and the railroad facilities are altogether inadequate, the companies being poorly provided with freight cars. Under these circumstances, the natural difficulties or impediments to Florida phosphates are at present rather discouraging, and it is only when these have been cleared away by the gradual development of the state that the ores of all grades will begin to come forward in large quantities.

Their average richness in phosphoric acid is, on the whole, very satisfactory, though somewhat less than we were led to expect by the first reports, and a large proportion of the output will compare favorably with many other phosphates extremely popular with fertilizer manufacturers. Although more than a hundred companies have been already formed, with an aggregate capital of some $30,000,000, only 20,000 tons have been shipped to European ports. The bulk of this has, however, found a ready market at good prices; and it is quite certain that when speculation gives way to legitimate work, the constantly increasing demand will make of Florida the largest contributor to the world's supply.

RIVER MINING IN FLORIDA.

As the phosphatic nodules of the Florida rivers are no larger than coarse gravel, a very expeditious method of dredging them from the river bottom has been adopted. Upon the dredging barge is mounted a 10-in. centrifugal pump with a suction pipe running down to the river bottom. The pump brings up a stream of mingled sand, water and phosphatic pebbles which is discharged into a revolving screen. The sand and water flow back into the river and the washed pebbles are collected in scows, which carry them to the drying plant, where they are raised by a steam elevator, thoroughly dried, and either put in storage bins or loaded on cars for shipment. The total cost on board the cars is given by Dr. WYATT as $1.75 per ton. A half dozen companies are now at work mining the river deposits on this system.

MINING THE LAND DEPOSITS.

Through the courtesy of Mr. ALFRED KIMBER, C. E., we are permitted to make the following extracts from a private report on certain phosphate properties in Florida recently made by him.

The first discovery of rock phosphate seems to have been at Dunellon, Marion Co. In sinking a well for water the peculiar nature of the rock thrown up was noticed; enterprise prompted the analysis thereof and it was found to be rich in phosphoric acid.

On stripping off the surface soil, the surface of the phosphate bed is found to be very irregular. The hard nodules are nearest the surface, the spaces between being filled in by alluvial soil of varying depths from a few inches to 4 or 5 ft., at the bottom of which the nodules are found to be imbedded in "soft" phosphates, of almost snow-white color.

The "soft" phosphate is apt (unless great care is taken in removing it) to become mixed with the alluvial soil, and consequently becomes of lower grade in phosphoric acid and contains an increased percentage of iron and alumina.

The Dunellon Phosphate Company's mines are at Dunellon, Marion Co., about 20 miles from Ocala, along the Silver Springs, Ocala & Gulf R. R., and on the Withlacoochee River. The company is said to own about 13,000 acres.

Besides mining the land phosphates, the company is dredging the Withlacoochee River for river phosphates.

The company has opened 7 mines on its land, with one more under way. The largest of these covers but three-quarters of an acre; a depth of 45 ft. of phosphate rock has been reached without finding bottom.

On commencing work, the trees are cut down and the surface soil wheelbarrowed off to a distant dump selected by the Superintendent.

The illustrations on page 68, reproduced from photographs taken by Mr. C. H. COLBY, of Ocala, Fla., show the depth of the alluvial soil in newly opened mines on the Dunellon company's property.

The Superintendent can now see the surface character of the bed, its nodules, bowlders and the imbedding soft rock. An inclined roadway is then made, and with mules, carts, and wheelbarrows the soft rock is removed to a separate dump.

The soft rock can be loosened by the pick and consequently can be more readily removed than the hard rock, which requires sledging, the steel chisel and oftentimes blasting to reduce it to a size convenient for calcining or drying.

Taking a mine only three-quarters of an acre in area, it will be seen that at a depth of 30 to 40 ft. the plank wheelbarrow "drives" and the cart roadways become of very steep grade, and hoisting machinery is necessary.

At Dunellon the following is the simple but effective plan of development and machinery employed:

The drying sheds are located about 50 yds. from the mine, and are arranged on each side of and close to a branch track from the railway. From the mine to the drying sheds a trestle is built 12 to 15 ft. high, on which is a light tramway. Branches run to each of the drying

sheds and to the separate dumps for the soft phosphate and the surface soil.

At the terminus of the tramway, on the edge of the mine, is a wooden tower about 25 ft. high, which supports a wire cable running across the mine and anchored at the other side. A hoisting bucket holding about 600 lbs. of rock travels on this cable, and is controlled by an engine at the foot of the tower. When the bucket is filled it is hoisted to a point over the tramway and dumped into an iron car, which is then rolled to its proper destination in the drying sheds or on the dumps, according to the material contained.

The drying sheds are open-sided wooden structures about 35 × 70 ft. A layer of cord wood is piled on the ground about 6 ins. deep in this shed, and on top of this the rock is dumped to the height of 6 or 8 ft. The total amount of rock in the pile is about 300 tons. The wood is then fired and burns slowly for about 3 days, at the end of which time the rock is thoroughly dried.

It appears from this that the soft rock, while dumped separately from the surface soil, is not at present utilized. The reasons for this seem to be that the soft rock is dried with difficulty, is less easily handled, and contains less phosphoric acid and more iron and alumina. It is a queer fact, that just as contamination with phosphorus greatly depreciates the value of iron ore, so contamination with iron, in even small amount; greatly depreciates the commercial value of the phosphates. As stated by Dr. WYATT above, the contamination with iron and alumina is one of the chief defects of many otherwise valuable deposits in Florida. The cost of mining and drying hard rock is estimated by Mr. KIMBER at about $2 per ton on board cars.

PROGRESS IN DEVELOPING THE FLORIDA DEPOSITS.

With all the speculation in phosphate lands by men who bought only to sell again, which was a chief feature of the phosphate boom at the start, there has been a large amount of actual investment by companies who bought lands with the intention of mining the phosphate and not for speculation. Mr. JAY SHRADER, of Winter Haven, Fla., in a recent number of the *Manufacturers' Record*, states that about 30 companies have actually begun mining, and report an aggregate daily capacity of about 2,000 tons. The total capitalization of these companies is nearly $8,000,000, of which a large part is doubtless extremely "nominal." Besides these there are a host of incorporated companies which have not yet reached the point of actual mining, and their total nominal capitalization is given as about $18,000,000.

But taking only the companies in operation, it seems pretty certain that if anything like their reported capacity is reached the business will be greatly overdone. An output of 2,000 tons per day means about 600,000 tons per year, or far more than the yearly production of all the South Carolina companies. Doubtless the demand for phosphate rock is increasing; but it is not increasing so fast that an addition to the world's production of 600,000 tons per annum can be absorbed without affecting the market. In short, if the above figures of production are anywhere near correct, it is probable that the experience of South Carolina will be repeated in Florida; and productive capacity will go so far ahead of the market demand that some years will be required for the latter to overtake it.

But in closing, it may be well to call attention to a possible revolution in the use of phosphate of lime which may effect great changes in phosphate production and make the deposits of low grade phosphates and the phosphate contaminated with iron and alumina, which are at present of only nominal value, of very great economic importance.

At present phosphate of lime is chiefly used in the manufacture of artificial fertilizers. The rock is ground to powder and treated with sulphuric acid, which forms sulphate of lime and leaves the phosphoric acid in a soluble condition. This is then mixed with potash and some substance rich in ammonia, as slaughter-house refuse, or, in the South, cotton-seed meal. Thus the commercial fertilizer ready for market costs the farmer $30 to $40 per ton. Now, if the lime phosphate could be directly applied to the soil, the result might in the end be equally good and the expense be far less. Prof. N. S. SHALER discusses this question as follows in Bulletin No. 46. U. S. Geol. Survey:

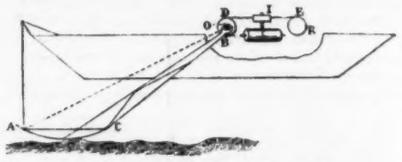
> At present the methods of using mineral phosphates are extremely costly. Not only is the material brought into the soluble condition by saturation in sulphuric acid, but it is then mingled with ammoniacal and other matter to increase its effect as a fertilizer. The result is that, although a ton of Carolina phosphate now costs but $6, the average price of the manufactured product to the consumer at the phosphate factories is about $30 per ton. It is probable that the essential value of the phosphatic ingredients to the plants of most soils is not enhanced by this costly treatment, though an incidental but dearly purchased gain, in the case of some crops, is obtained from the ammoniacal matter. The only effect of the superphosphatizing of the phosphatic matter is to make it more immediately absorbable by the plants. If placed on the soil without any other preparation than grinding, lime phosphate will slowly pass into a condition in which it may be absorbed by plants, while if treated with sulphuric acid it is for a time at least in a soluble state. That this treatment is not essential is well shown by the fact that the phosphatic matter derived from the rocks is brought into a condition for absorption by the ordinary process of decay in soils. Our present costly method of applying phosphates has come about through the commercial history of artificial manures, which is as follows:
>
> Before guanos were brought into use, the English farmers had learned that they could profitably use the phosphatic marls of their Tertiary and Cretaceous deposits without any artificial preparation. If guanos had not existed it seems likely that mineral phosphates would have always been used in this way. When the Peruvian guanos came into use they afforded a much more stimulating material than any other purchasable manures, and in a short time they established the type of commercial fertilizers. When the sources of supply of these guanos became in part exhausted, artificial compounds, formed on a basis of rock phosphates or apatites, were devised to take their place. These were made to imitate the effect of the guanos as closely as possible. Like them, they gave a quick though temporary stimulus to the soil, enabling the farmer to obtain the greater part of the return for his investment in the season following the application of the high-priced manure.
>
> In this way a habit has been established in the art of using phosphates, as well as in the composition of the material, which, like all commercial habits, is hard to overcome. The question to be determined is as to the utility of phosphates with other modes of treatment than those which are applied to the imitation guanos. At present the treatment requires the commingling of the lime phosphate with a number of costly substances. The manufacture can only be advantageously carried on at points remote from the districts where the materials are produced and remote from the fields where they are used, so that the costs of transportation are great.
>
> In most cases the fitness of the soil for grain tillage is measurably proportionate to the phosphatic contents. It seems almost certain, though not yet demonstrated, that the greater part of the phosphatic matter in the soil is in the state known as *insoluble*, and that it only becomes in small part, year by year, soluble, or, in other words, fitted for assimilation by plants. Whenever the soil contains the quantity of lime which characterizes the better class of Kentucky soils it is supposed that even if soluble phosphatic manures are applied, the superphosphate becomes again insoluble by taking up a molecule of lime. It is therefore an interesting question as to the means by which the lime phosphate enters the plants. It may be that the solution is effected through the action of the various humic acids of the soil, or it may arise from some specific change which takes place at the contact of the soil with the roots. It is evident that this point requires precise determination, for on it will depend further experiments as to the methods of applying phosphatic manures.
>
> There is yet another point on which we need experiments. Many of our rock phosphates, especially those which are distinctly bedded, contain low percentages of phosphatic matter. Many of our lime phosphates contain crystals of apatite and calcite so intermingled that it is not possible to separate them; yet from these deposits it will be easy to produce a mixture of lime carbonate and lime phosphate containing from 10% to 20% of phosphoric acid. The value of such material for manure has never been determined. If it can be used in a way which will give to the fields the full value for both the lime and the phosphorus it will open a way for an extensive production of cheap fertilizers.

An Apparatus for Automatically Registering the Profile of River Bottoms.

At the International Congress of Interior Navigation, lately held at Frankfurt-on-Main, among other apparatus the following device was exhibited for registering antomatically the depths of the thalweg of the River Elbe:

This machine was first described in 1885 in the *Centralb'att der Bauverwaltung*. It is made up of a beam armed with the iron horns *A B*, terminating at *A C* in a curved part, which is intended to glide over the river bottom. The other end of the trailing beam is connected by a forked catch with a horizontal shaft turning in brasses mounted on the gunwales of a boat. This connection is so made that when the depth of water decreases, the trailing arm is lifted at the lower end and the shaft *O* is turned to a corresponding degree.

Upon this shaft *O* is a flexible sheet *D E* kept in a state of tension by a second drum *E R* provided with a tension spring. Upon this thin sheet or belt is mounted a carrier for a pencil *I*, which moves longitudinally over another drum uniformly revolved by



The Stecher River-Profile Register.

clockwork and provided with a paper registering band arranged in the usual manner. A second fixed pencil having its position determined at the commencement of each operation, traces upon the same sheet of paper a line corresponding to the water surface, so that the profile of depths is complete at one operation. Finally a third pencil, fitted with a spring handle, enables the observer to trace the kilometric and other data of distance traversed by the boat.

The theory of the apparatus is thus described in the *Annales des Ponts et Chaussees*, April, 1891, from which this description is taken:

The curved part *A C* of the loaded beam is the development of a circle of which *O* is the center and *O C* the radius. Then

$C' F$ = arc $C' C$, $C' N$ = arc $C' C'$ and $C' C' F - C' N$ = arc $C' C$; $C' F - C' N$ is the depth sought. This depth is equal to the arc described by the cir

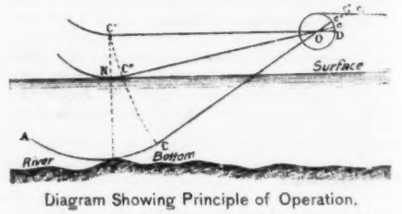


Diagram Showing Principle of Operation.

cumference of the shaft *O* when the beam passes from the position *O C* to the position *O C C'*, multiplied by the expression $\frac{O C}{O D}$. But the arcs described by the axle *O* are equal to the longitudinal displacement of the moving web, and this displacement is registered by the pencil on the paper. The result is a graphical register of the depths of a river, on a scale $\frac{O D}{O C}$, on the line followed by the trailing arm.

This apparatus is invented by Mr. STECHER, and is made by Mr. M. O. ZEUNER, of Dresden, and without the boat it costs $171, including $25 for the right to use the patent. In 10 days soundings were made over 237 miles of the Elbe. The most convenient speed, for the securing of the best results, is 3.72 to 6.2 miles per hour. The navigation engineer of the Elbe is well satisfied with the result of these soundings.

Distribution of Population in the United States in Accordance with Altitude.

By a late bulletin of the Census Bureau, No. 89, it is shown that about one-sixth of the population of the United States live less than 100 ft. above sea-level, and more than three-fourths live below 1,000 ft.; and 90% of the total population live below 5,000 ft.

In distribution in accordance with occupation, we find that below 500 ft. is included that part of the population engaged in manufacturing, in foreign commerce, and most of that engaged in raising cotton, rice and sugar. The territory between 500 and 1,500 ft. in elevation includes the greater part of the prairie states and the grain-producing states of the Northwest. East of the 98th meridian the 1,500-ft

contour is practically the upper limit of population, all the country above that being mountainous. The population lying between contours 2,000 and 5,000 ft. is found mainly on the slope of the great western plains, and includes the great "arid region." Nearly all lands above 3,000 ft. must be irrigated for agricultural purposes.

The density of population is greatest on the sea coast and diminishes gradually and quite uniformly up to 2,000 ft., above that contour, the population is quite sparse. The densest population for the elevated regions is found at the eastern base of the Rocky Mountains and in the valley of the Great Salt Lake, regions lying between 4,000 and 6,000 ft. above sea level.

The average elevation of the country, excluding Alaska, is about 2,500 ft. The average inhabited elevation, taking note of their distribution, was 687 ft. in 1870; 739 ft. in 1880 and 788 ft. in 1890. The relative population compared with the altitude above sea level is thus given:

Altitude, in feet.	Population, in thousands.			Population per square mile.			Increase in population per square mile.	
	1890.	1880.	1870.	1890.	1880	1870.	1880-'90.	1870-'80.
0 to 100..	10,387	8,273	6,441	51.8	41.3	32.2	10.5	9.1
100 to 500..	13,838	11,654	9,240	35.6	30.0	23.8	5.6	6.2
500 to 1,000..	23,947	19,813	15,914	43.9	36.3	29.1	7.6	7.2
1,000 to 1,500..	9,431	7,256	5,136	23.8	18.3	13.0	5.5	5.3
1,500 to 2,000..	2,354	1,597	978	9.8	6.7	4.1	3.1	2.6
2,000 to 3,000..	1,151	723	405	4.4	2.7	1.5	1.7	1.2
3,000 to 4,000..	381	185	124	2.1	1.0	0.7	1.1	0.3
4,000 to 5,000..	296	135	75	1.1	0.5	0.3	0.6	0.2
5,000 to 6,000..	487	270	137	2.2	1.2	0.6	1.0	0.6
6,000 to 7,000..	161	98	56	1.0	0.6	0.3	0.4	0.3
7,000 to 8,000..	94	59	33	1.0	0 6	0.4	0.4	0.2
8,000 to 9,000..	43	30	14	1.1	0.9	0.3	0.2	0.6
9,000 to 10,000..	39	45	3	2.0	2.3	0.2	0.3	2.1
Above 10,000..	10	9	2	0.5	0.5	0.1	...	0.4

This material has been compiled chiefly from the topographical work of the U. S. Geological Survey and the maps of railway companies; and a contour map of the United States has been prepared on a scale of 1:2,500,000, or about 40 miles to 1 in. This map shows contour lines at 100, 500, 1,000, 1,500, 2,000 ft., and thence by 1,000 ft. up to 12,000 ft. above the sea level. This map has been published by the U. S. Geological Survey.

The Garrucha Aerial Ropeway.

The plant here illustrated is used in transporting iron ore from the mines in the district of Garrucha in the south of Spain, and we are indebted to *Industries* for the views given and the matter here condensed.

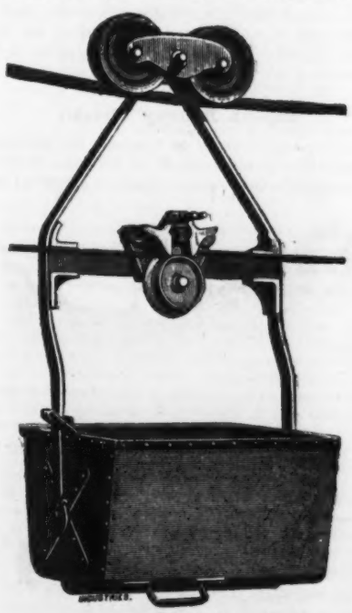


Fig. 1.

This system of rope transport is known as the Otto, and its English representatives are Messrs. Commans & Co., of 52 Gracechurch St., London. The chief feature of note is the use of two fixed carrying ropes, along which the buckets are hauled by a smaller, endless running rope. The piers are made of either iron or wood, according to their height and the strain upon them, and the general design is shown in Figs. 2, 3. The longest clear span is 918 ft.

FIG. 2.

FIG. 3.

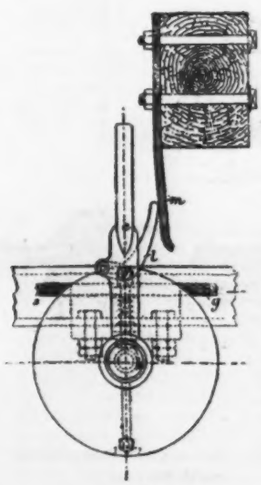


FIG. 4.

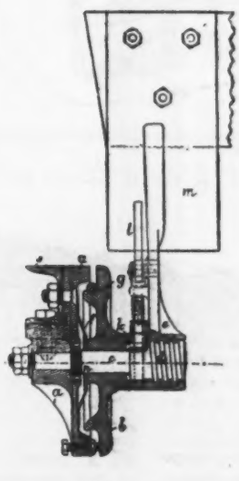
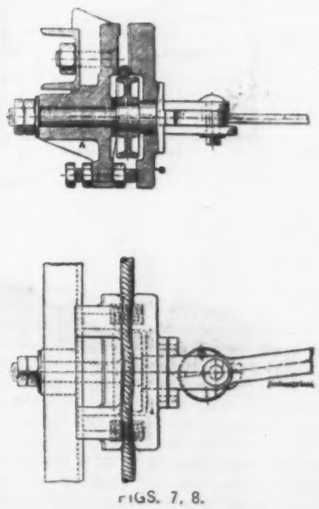


FIG. 5.



FIGS. 7, 8.

across a deep and rocky valley, near Villa Reforma. On this span no less than 6 empty and 6 full buckets are suspended at one time between the supports, and one pier is 118 ft. high.

The buckets used (see Fig. 1) have a capacity of 7 cwt., and the same cut shows the relative positions of the fixed and running ropes. The details of the grip for attaching the buckets to the hauling line are interesting. For lines of easy gradients friction grips are employed of two types, the first for grades up to 1 in 6, as shown in Figs. 4, 5. This grip consists of two smooth-faced disks *a* and *b*, one rigidly attached to the cross-bar of the hanger, and the other being free, when out of action, to revolve and act as a guide and supporting roller for the hauling line. The spindle carrying the movable disk has a square thread on its outer end and carries a lever, the base of which forms the nut. If the lever is hanging down the disks do not grip the rope, and are kept apart by a spring. On raising the lever, however, through 180° the disks approach each other and tightly grip the hauling rope between them. A small spring trigger prevents the lever from falling while in transit.

For gradients from 1 in 6 up to 1 in 3 the grip shown in Figs. 7, 8 is used. This is a friction grip with corrugated jaws, *A B*, in which the movable plate, *B*, does not revolve, and the pressure is ob-

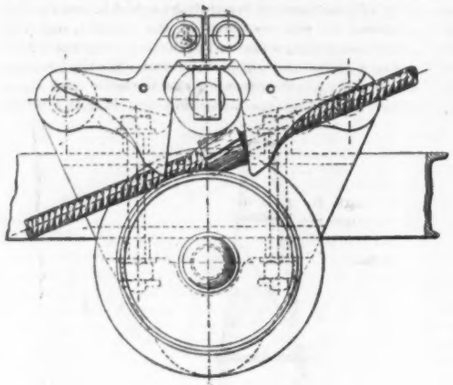


FIG. 9.

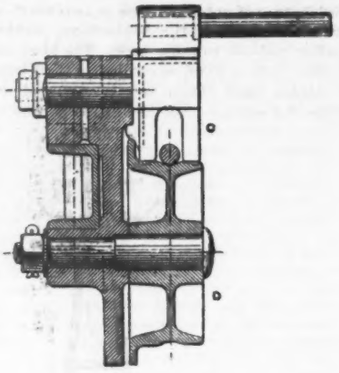


FIG. 10.

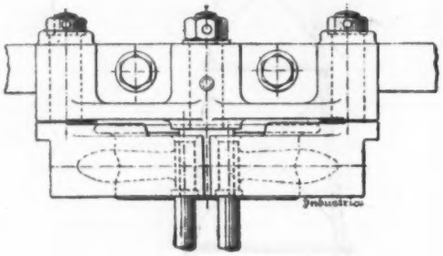
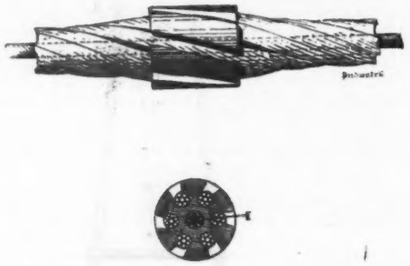


FIG. 11.



FIGS. 12, 13.

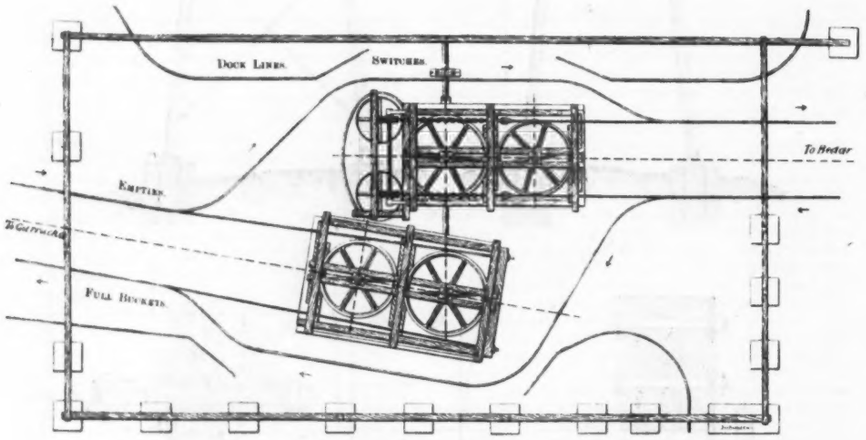


FIG. 14. ANGLE STATION AT PUERTO DEL CORONEL.

gear, pins are attached to the upper ends, which come in contact with guide rails at the stations. These rails raise the pawls, automatically release the hauling rope and permit the bucket to be switched off on the shunting rails at these stations.

The "knot," shown in Figs. 12, 13, has a star section with an outside diameter slightly in excess of that of the hauling rope, and the strands of the rope lie in the helical groves of the knot, with the ribs projecting far enough to catch the pawls. This knot is made fast to a steel wire strand *E*, about 6 ft. long, which takes the place of the hempen core in the hauling rope. This arrangement distributes the strain over 6 ft. of the hauling rope, which latter tightly grips the strand. It is quickly attached and can be renewed when worn.

As these lines can not be worked around curves, angle stations are necessary, as shown in Fig. 14, which represents one of these stations at Puerto del Coronel. When a bucket arriving from Bedar reaches the shunt rail at the angle it is automatically disengaged from the hauling rope, as above described, is switched on to the shunt rail and run around by hand to the carrying rope of the next section. To avoid the violent impact of the knot and coupling, the operator gets a signal by a bell when the knot is approaching and he pushes off the bucket at about the same rate that the hauling rope is traveling. If the line is not working to its capacity the empty buckets are docked at this station on sidings provided.

The Garrucha line is divided into four sections; a 30 HP. engine driving the two steeper sections and a 70 HP. engine operating the other two. Fig. 14 also shows, in plan, the method of taking up the slack of the hauling rope by means of two balance weights sunk in a pit at the end of the Bedar section. The carrying ropes are weighted in a similar manner. The loading into the buckets is done from a hopper, holding about 800 tons, furnished with spouts and swinging doors.

The profile Fig. 15 shows that the loading station at the mine is 905 ft. above sea-level. After leaving this the line crosses a number of deep valleys, one of these being nearly one-half mile wide and 330 ft. deep. The highest ridge traversed is 1,174 ft. above sea-level. There are three angles in the whole line.

The 600 buckets usually at work travel at the rate of about 3 miles per hour; and working a double shift of 8 hours, as much as 900 tons per day of ore has been transported to the sea coast. The line was surveyed, erected and put into operation in 10 months at a total cost of $130,000. In addition to the long span mentioned there are other spans of 328 ft. to 750 ft., and the average distance between supports is about 130 ft. There are about 450 of the Otto aerial ropeways at work in various parts of the world.

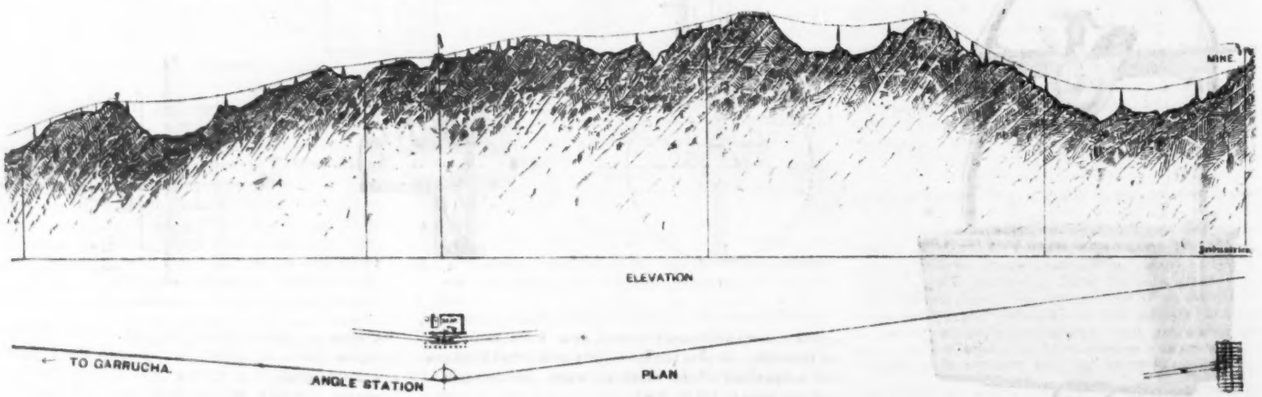


FIG. 15. PROFILE AND PLAN OF PART OF THE GARRUCHA LINE.

English Railway Bridges.

The *Financial News*, of London, has published some of the statements made by Sir JOHN FOWLER in his report to the London, Brighton & South Coast Ry. Co. upon the bridges of this line. After the accident caused by the failure of the Portland Road bridge, the company engaged Sir JOHN FOWLER to make an examination of all the bridges upon its line, and the recommendations made in this report

tained by a lever and eccentric, as shown. Both forms of grip work well.

On this line there are gradients of 1 in 2½, and as the friction grip could not be relied upon here a pawl-grip, shown in Figs, 9, 10, 11, is employed. Here two symmetrically-placed pawls, *C C*, free to move in a vertical plane, have forked ends, which drop down on each side of the rope attachment, shown in Figs. 12, 13. The hauling rope is carried on the roller, *D*. To throw the pawls in or out of

as briefly noted in our last issue, are very surprising, and are likely to start a very general investigation of metal railway bridges in England, especially of the older structures on the less important roads and branches. The above-mentioned paper has printed the following extracts from the report:

The Victoria Bridge is a very strong and good bridge in every respect, and will be so for very many years. . . . I walked over the ground of the site of the Ouse viaduct, and examined every pier and arch. I found this fine structure, which is exceptionally strong, in excellent condition.

The Shoreham Viaduct consists of 36 spans of 30 ft. each, with cast-iron girders resting on timber piers. The time has arrived when this viaduct would require renewal in a few years by substituting iron cylinders for timber piers, and wrought-iron girders for cast-iron. I recommend, however, that this renewal be carried out as soon as arrangements can be made, and while the viaduct is in a perfectly safe state. Being a work of some magnitude, it will occupy longer time than any other work of renewal, and I think it will be more convenient and economical to construct the new viaduct alongside the old one, and thus avoid all interference with traffic.

Besides the Shoreham viaduct there are above 20 bridges which, in my opinion, should be renewed by the substitution of wrought iron (or, preferably, steel) for cast iron during the next 12 months, or sooner if possible, and about 60 others should then be reconstructed.

Before any actual steps are taken with reference to the works of any bridge, I advise a very early conference with Mr. BANNISTER, the manager of the traffic department, myself and Sir BENJAMIN BAKER, with a view to settle the best order to be taken with the work, having reference to traffic convenience, season of the year and other considerations, it being understood that all the 80 or 81 bridges are to be reconstructed in the shortest time reasonably possible, and not exceeding two or three years from the present date. The advice given in this report for the gradual construction of the bridges is based upon considerations affecting the vast majority of railways in the kingdom.

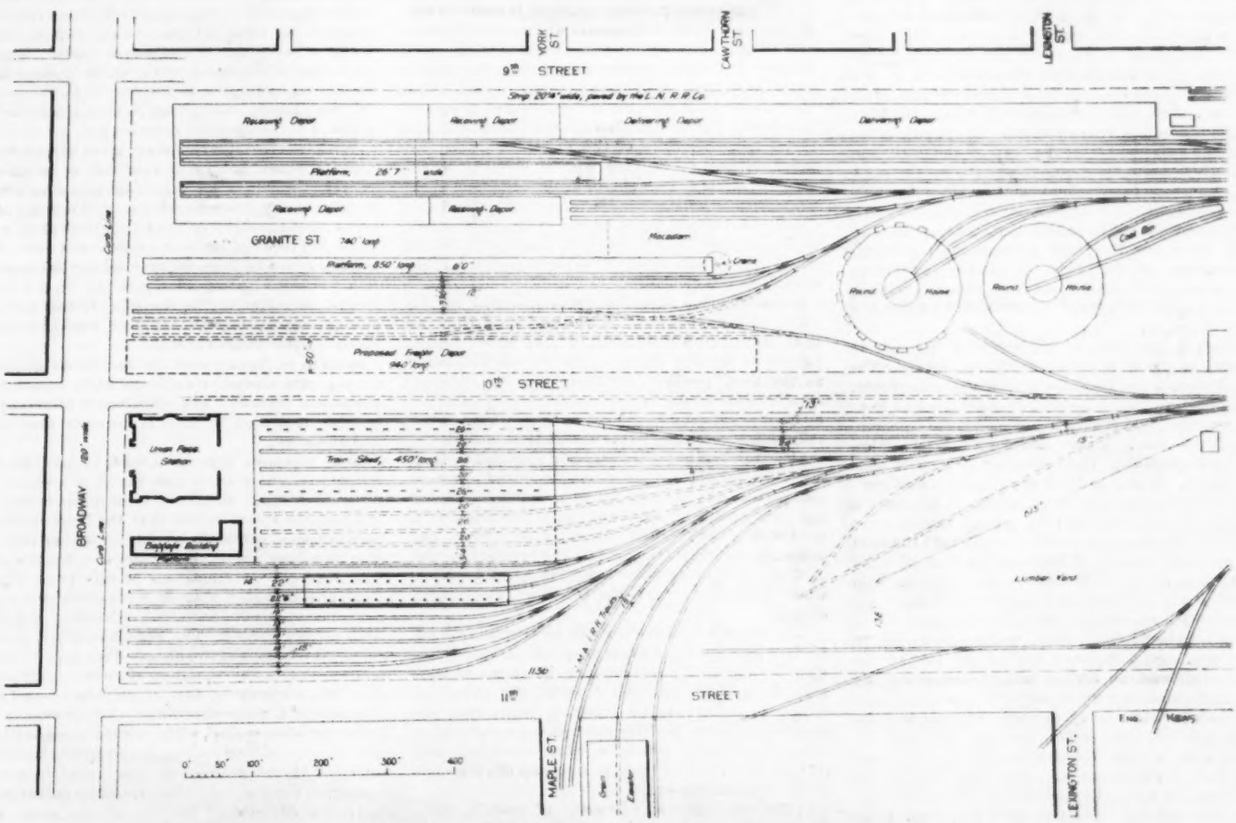
Mr. BANNISTER is Chief Engineer of this road. It is said that the Shoreham viaduct was opened in 1847, and that the breaking weight of the girders is more than 50% below the standard new required by the Board of Trade. The following general remarks are from the *Financial News*:

Thus far the Brighton line; and it seems conclusive that the work to be done will cost an amount of money considerably larger than even the most extravagant estimates that were current a few days ago. How this expenditure is to be met is not a question with which we need concern ourselves just now. It will have to be met somehow, and the urgency of the work, upon which Sir JOHN FOWLER lays so much stress, is not the least important consideration, from a financial point of view, that has to be borne in mind.

But the Brighton line is not the only one affected. The considerations leading to these recommendations, in the opinion of Sir JOHN, affect *all other railways in the country of a similar character*. It is evident from this statement that most of the Southern lines, and, we believe, some of those more directly connected with the metropolis, together with many of the smaller branches, will be called upon almost immediately to put their bridges in order. The safety of the traveling public is gravely imperiled by the existing condition of things, and, in the opinion of scientific experts, the remedy cannot be applied with too great expedition.

Union Station and Terminal, Louisville, Ky.; Louisville & Nashville R. R.

The Louisville & Nashville R. R. has recently made extensive improvements to its terminal arrangements at Louisville, Ky., including the construction of a new union station at the corner of Broadway and Tenth St. Mr. R. MONTFORT, M. Am. Soc. C. E., is Chief Engineer, and Mr. F. W. MOWBRAY, Architect. The yards for the storage of passenger cars are on the right of the station, and the freight yards on the left. The accompanying cut shows the general plan of the new terminal arrangements.



PLAN OF NEW TERMINAL ARRANGEMENTS; LOUISVILLE & NASHVILLE R. R. LOUISVILLE, KY.

The station building is of Bowling Green limestone, and the baggage building of Bedford, Ind., limestone. The main part of the building consists of a large and lofty waiting hall, on the sides of which are the ticket and sleeping-car offices, parcels office, dining and refreshment rooms, lavatories, etc., all easy of access. The offices of the telegraph operator, train dispatcher, superintendent, etc., are on the second floor, and are reached by galleries along the sides of the waiting hall. This hall is finished and decorated in tints of brown and buff, and is well lighted by a stained glass skylight and a stained glass rose window at each end. A very complete system of ventilation is provided. Two fans draw in fresh air at the top of the tower, force it through a network of hot air pipes, and then through ducts to the various rooms and offices. A third fan exhausts the foul air and forces it out at a shaft on the other side of the building. The fans are driven by separate engines supplied by the Buffalo Forge Co. The lighting includes electric light and gas, combination fittings being used. The electric wires are led through conduits in the walls, the conduits having junction boxes at intervals. If any wire becomes defective, the fixture may be taken off, the wire unfastened and a string tied to its end. The nearest junction box is then opened, the wire pulled out, and a new one pulled in by means of the string. The cost of the building is about $200,000.

The train shed is about 450 ft. long, but does not reach within 50 ft. of the station, that space over the main platform being covered by a lower slant roof so as not to shut off the light from the building. The width of the train shed is 92 ft. between columns and extends 16 ft. beyond them, the total width being 124 ft. The roof is high and light, and the trusses are built of old bridge material, carefully selected. The columns and trusses are painted gray, with a darker shade for the lower part of the columns. This color was selected as not likely to show the effect of dirt or the smoke from the engines for a long time, as it will only grow darker. There are 6 tracks in all, 4 of these being between the columns, and provision has been made for a future widening, with 3 more tracks, as shown by the dotted lines. The tracks are laid with 80-lb. rails, laid upon continuous iron plates upon longitudinal timbers 12 × 12 ins., which rest on wooden crossties. The rails are secured to the longitudinals by spikes, which pass through the iron plates. This arrangement makes a very substantial track. The platforms and the sidewalks in front of the station are paved with lithogen, an artificial stone similar to that used for the platforms of the new suburban stations on the Harlem division of the New York Central & Hudson River R. R.

The Brooklyn Water-Works Extension.

(WITH INSET.)

IV.

(*Continued from page 546.*)

BALDWIN STORAGE RESERVOIR.

As described in previous articles water passes from the five new supply ponds through a brick conduit to the Millburn pumping station, from which it is forced through a 48-in. cast-iron main to a large storage reservoir. From this reservoir water passes through a 48-in. main to a new pumping station at East New York, where it will be pumped to the Ridgewood distributing reservoir. A 36-in. main connects the new storage reservoir with the present aqueduct from the old supply ponds to East New York.

Our inset this week shows a cross-section through the new Baldwin storage reservoir embankment and details of the inlet and outlet chambers.

The reservoir will have a storage capacity of about 414,000,000 galls. It is irregular in shape, about 1,200 × 2,000 ft. at the top of the inner slope. At the outlet chamber the water is shown by the drawings to be about 19 ft. deep. The embankment is of earth, 20 ft. wide on top with an inner slope of 1½ to 1 and an outer of 2 to 1. The inner slope has a 15-in. paving on a layer of gravel varying in thickness from 6 ins. at the bottom to 30 ins. at the top, as shown by the section. The embankment has a puddle heart-wall extending from the natural surface to within 3 ft. of the top. This wall is stepped from 4 ft. in thickness at the top to 7 ft. at the bottom. The puddle is carried in a 2-ft. layer from the foot of the wall horizontally beneath the dam, on the natural surface to the line where excavation begins and then down the inner slope, beneath the 6-in. layer of gravel already mentioned. A rubble masonry wall 3 ft. wide and, with the coping, 3 ft. high, protects the top of the inner slope. At the foot of the inner slope there is a toe of concrete. The bottom of the reservoir is covered with a 2 ft. layer of puddle above which is a layer of gravel.

Water is admitted to the reservoir through an inlet about 800 ft. from its southwest corner. The outlet chamber is about 350 ft. from the same corner. The end elevation of the inlet chamber, as seen from the reservoir, and the cross-section convey a general idea of the same. A plan and longitudinal section were not available. This chamber is in three compartments. Water is discharged into the first compartment through four 48-in. pipes. It falls over a vertical dividing wall into the second compartment and from this down an inclined plane into the final compartment, the top of the outer wall of which is but slightly above the bottom of the reservoir. This chamber is of masonry, on a timber platform.

The outlet consists of three parts, a chamber in the embankment from which water is admitted to the pipes, a gate chamber beyond the foot of the outer slope and an arched culvert connecting the two and containing the 48 and a 36-in. main. Both chambers are of masonry, the inner of stone and the outer of brick. The outlet chamber is 10 × 20 ft., with a 12-in. dividing wall across the center, pierced with arched passageways. Provision is made for admitting water to the chamber at three different levels through four openings, each 2 ft. 8 ins. wide and 3 ft. high, shown by elevation *E F*. The reservoir side of the chamber is flanked with masonry walls and the space between is paved as shown by the plan and by section *A B*.

The culvert is of brick, 13 ft. 6 ins. wide, covered by a semicircular arch springing from walls 1 ft. 9 ins. high.

The gate chamber is 27 × 28 ft. It contains an X-shaped casting with four valves. A branch from the 48-in. force main passes around the corner of the reservoir, enters the side of the chamber and joins the 48 and 36-in. mains through the special. An examination of the plan will show that by changes in the opening and closing of the four gates water can be passed from the reservoir through the 48-in. main, to the gate chamber and thence into the 36-in. main or vice versa; also, that the water from the force main may be passed around the reservoir and into either of the mains leading to East New York, and even into the reservoir through the outlet chamber.

The outlet chamber is provided with an overflow pipe which connects with a drain pipe passing through the culvert. The whole structure rests on a platform of spruce timber covered with concrete. Sheet-piling is driven at each end of the paving between the flank walls of the outlet chamber. The slope angles of the embankment are shown in the plan by dotted lines.

Some of the principal items in the engineer's preliminary estimates were as follows:

Earth excavation	558,000	cu. yds.
Soiling	8,000	"
Puddle	210,000	"
Gravel	28,000	"
Ballast, or gravel for slopes and walk	15,200	"
Stone paving	14,500	"
Concrete	3,000	"
Rubble masonry	2,700	"
Brick masonry	450	"
Sodding	48,000	sq. yds.

The quantities of clay to be used for the puddle were optional with the engineer, but it was estimated that for the slopes 40% and for the bottom 20% of pure clay would be used. The other material was to be the best found in the excavation.

Electro-Deposition and Its Bearing Upon the Preservation of the Bottoms of Iron and Steel Ships.*

When the same galvanic current is made to pass through several metallic solutions contained in separate vessels, it is found that the weights of the metal deposited at the negative poles are in the ratio of their equivalent weights, and that in each cell of the battery as much zinc is deposited as is equivalent to the metal deposited in each electrolytic cell. If we take chlorides of the metals, we find that equal volumes of chlorine will be given off at the positive, while the weight of metal deposited at the negative pole will vary as its valency The elements, chiefly non-metals, which appear at the positive pole during electrolysis, are said to be negative elements, while those which come off at the negative pole are called positive elements.

Formerly much importance was attached to this electrical behavior, and all elements were arranged in an electro-chemical series; in this series oxygen figured as the most negative member and potassium as the most positive member, and the chemical affinity of the elements was supposed to be governed by their electrical differences; so that, when chemical union occurred, opposite electricities united.

Although less importance is now attached to their electrical relations, it is generally looked upon as established that the behavior of elements on entering into and being expelled from combination is governed by the thermal changes taking place, and in chemical changes the tendency is toward the production of that body or aggregation of bodies in whose formation there is the greatest development of heat.

The principles of electrolysis receive a very important application in electro-deposition, which consists in depositing metals from solutions of their salts by a feeble galvanic current, the object on which the metal is to be deposited being made the negative pole, the positive pole consisting of a plate of the same metal which is being deposited; and this plate by its slow solution keeps up the strength of the solution of its salt.

In this way copies may be made of medals, casts, etc., as follows: A mold is first made in fusible metal or plaster, and coated with black lead in order to make it a conductor of electricity; it is then connected with the zinc plate of a Daniell's cell and is immersed in a solution of the salt of the metal to be deposited (generally a cyanide); a plate of the metal is then attached to the copper of the cell and also immersed in the solution of the salt; the metal is then slowly deposited on the mold. In the same way copies may be taken of etchings on metal and engravings, and metallic substances can be electro-plated.

In order to apply a coating of gold or silver to copper, brass, bronze, or other metallic alloy, the surface of the metal to be electro-plated must be first thoroughly cleaned by boiling in a dilute solution of sodic hydrate; the metal article is then suspended by a wire in connection with the zinc of some form of feeble battery in the gilding or silvering bath; a plate of gold or silver, as the case may be, is attached to the negative element in the battery, and forms the positive pole in the plating cell.

* Contributed by Lieut. C. W. JUNGEN, U. S. N.

Copper, bronze, brass and German silver can be electro-plated directly, but steel, zinc and tin require to be coated with a thin film of copper. Frequently the best electro-plated goods have a thin film of palladium deposited on their surface in order to avoid tarnishing.

A great deal of interest attaches to the electro-chemical behavior of metals upon each other when excited by various solutions from the bearing this has upon the condition of the bottom of ships. This question arose early in the days of wooden vessels, because copper sheathing was used to protect the timber from fouling and against the ravages of the *Teredo*. The copper acted in preventing fouling by reason of its forming in contact with salt water oxy-chloride of copper; this being poisonous retarded the growth of the germs of certain forms of animal and vegetable life, while the wasting from its surface from oxidation threw off barnacles and similar forms of fouling as obtained hold in spite of the poisonous character of the copper salts. The copper, however, wasted too rapidly, and to prevent this Faraday suggested the use of zinc plates in metallic contact with the copper. The result was the formation of a galvanic couple, in which zinc was the positive metal, *i. e.*, the metal dissolved. The retardation of the destruction of the copper, however, defeated its own purpose, as the copper did not waste or exfoliate with sufficient rapidity to throw off barnacles and sea growth; in fact, the current tended to cause the deposition of earthy matters on the copper, converting it into a surface well adapted to the growth of marine life.

With iron and steel ships the same considerations come into play, and great care has to be taken to prevent the skin of the ship from becoming electro-positive to any other substance. The bearing of the screw shafts and the valves for the escape of waste water are made of alloys of copper, and near these where excited by salt water a strong galvanic action would set up, attended with the rapid destruction of the steel of the shafting, rudder-post and plating, because the iron or steel would be electro-positive to the copper alloy.

In order to prevent such destruction a zinc protector is placed around all openings where copper or its alloys are present. The zinc being more electro-positive than iron or steel, is the metal acted upon and dissolved.

Many attempts have been made to cover the bottom of iron ships with zinc plates to prevent corrosion, but, apart from the mechanical difficulties of attachment, it is found that the large surface of metal exposed causes so strong an action that the zinc sheathing wastes too rapidly to make it a practical method. Modifications of this idea, such as using finely divided zinc as a constituent of a protective composition, have been advocated and tried with varying results. The consideration of electro-chemical relations of the metals must also be taken into account in the mooring of vessels, as it is evident that the making fast of an iron or steel ship alongside of a copper-bottomed ship, or even to another iron ship coated with certain compounds of copper in use as anti-fouling compositions, would be sufficient if the connection were made by a steel hawser, or even a wet rope, to set up galvanic action at the expense of the iron or steel ship. For the same reason copper-bottomed vessels should not be made fast to iron piers or steel ships to piers protected by copper.

ROCKING GRATE BARS are being tried on the Madras Ry., India, according to *The Indian Engineer*, of Calcutta. Two longitudinal iron bars are attached to the firebox ring, with slots for the transverse bars. The shaking rod is connected with a cam on the trailing axle of the engine, and is also connected with a perpendicular rod having a cap on it projecting through the foot plate of the engine. When the fireman finds his firebox is becoming choked with clinker and ashes he presses the cap, when the gearing becomes connected with the trailing wheel, whose motion rocks to and fro the longitudinal bars and allows the clinker and ashes to fall out. This clearance of the firebox results in a great saving in fuel. Shaking grates of a form already in extensive use in stationary boilers, and operated by the fireman by means of a lever, are being tried in this country.

Irrigation and Irrigation Systems in San Bernardino County, Cal.

BY F. C. FINKLE, C. E.

(*Continued from page 2.*)

THE RIVERSIDE CANALS.

The Riverside canals are generally spoken of as three in number, viz.: the Lower, Upper and the New, but practically there are only two canals, for the New Canal, after running about 4 miles, and before it reaches Riverside, drops to the level of the Upper Canal, empties into it and from that point the two are the same.

The New Canal was constructed to take water higher up the Santa Ana River, thereby saving what was lost by evaporation and percolation between

Fig. 1.—Tunnel on Jurupa Canal.

this point and the point where the Upper Canal is taken out. The amount of water lost between these points was well worth saving, as the river widens out and the bottom is very sandy, causing most of the water to sink down.

The Lower Canal is simply an open-earth ditch except at one or two points where a flume is required to cross an arroyo. The water is diverted by means of a brush dam, which is carried away by the high water every rainy season and has to be rebuilt constantly. The Lower Canal was the first one built in the early days of the Riverside settlement, and consequently is a very crude and cheap affair, and contains no feature of interest to engineers. But under it are the oldest orange orchards in Riverside, and therefore to the tourist this is one of the most interesting parts of the settlement. The Upper Canal was built later, after most of the lands under the Lower Canal were improved. The Upper Canal, as the name denotes, was taken out higher up the river and the object was to develop that portion of the present Riverside settlement which lies higher than the Lower Canal. It was constructed on the same plan as the Lower Canal, but is longer.

Fig. 2.—Siphon on Jurupa Canal.

It is to the New Canal that engineers must look to find features of interest. The manner of diverting the water into the New Canal, however, is no more improved than in the case of the other two, the same old brush dam being used. This, during the rainy season, causes the company a great deal of trouble and expense, as they have to keep men there constantly to watch it, and still it is swept away many times during each rainy season. It is necessary that the water be kept in the canal continually, as it is used all the time for power purposes, as will be explained further on. The Santa Ana River near the head of the canals has a wide, sandy, treacherous bed. During the rainy season the river flows full and sometimes overflows its banks, and all the time it carries large quantities of débris and driftwood. The fall of the river at this point is over 30 ft. per mile, and the velocity of the water is therefore very great during floods. Such is the condition of the stream where the Riverside canals are taken out, and it is evident that it is not easy to handle at all times, especially not with a brush dam made by driving poles in the sand and weaving them together with brush.

After the New Canal has been diverted in this way it follows the bank of the river for about three-quarters of a mile, when it crosses the river on a pile trestle similar to that of the Jurupa Canal. The length of this trestle is 6,733 ft.

After leaving the flume the canal, for a few hundred feet, is a paved and cemented ditch. It then enters a tunnel 3,271 ft. in length. This tunnel is timbered, and the water-carrying cross-section is concreted and plastered with Portland cement. It is quite similar to the tunnel on the Jurupa Canal which was referred to in our issue of July 4, and a view of which is shown in Fig. 2 (Fig. 1 is a view of the invented siphon of three 24-in. pipes referred to in our issue of July 4). After leaving the tunnel the canal is an open-earth excavation until it reaches the point where it drops 40 ft. vertically, through an iron chute to a turbine, and after leaving the turbine the water follows the Upper Canal, as already explained above. The water power developed by the drop is used to generate electricity for lighting the city of San Bernardino, 8 miles distant.

Besides the works of the Riverside Water Co., already described, there are a great many miles of lateral canals and ditches used in distributing the water over the tracts of land which are irrigated. Riverside is the oldest place in the country where irrigation has been scientifically carried out on a large scale, and shows what beauty and profit can be obtained from a desert in San Bernardino Co. by the magic touch of water.

THE GAGE CANALS.

After the Riverside irrigation system had been completed there remained between the mountains and the upper canal, on the south of the settlement of Riverside, a tract of 15,000 acres of dry land. Everybody admitted that the land was perfect for oranges, but no one could see where the water was to come from to irrigate it. All the water at a sufficient altitude to cover the tract was already applied to other land, and no one dreamed that water could be obtained near enough to the tract to make it profitable to conduct and distribute it where it was needed. But the far-sightedness and energy of Mr. MATHEW GAGE, now of Riverside, solved this question in a manner which made it both profitable to himself and his associates and a blessing to the community in which he lives.

Fig. 3.—Artesian Wells to Supply Gage Canal.

Mr. GAGE knew that a large number of flowing artesian wells existed in and around the city of San Bernardino.

The wells existing in the San Bernardino Valley were scattered over a territory bounded by a radius of 4 miles, and were mostly small wells, 2 and 3 ins. in diameter, used to supply domestic water to the settlers in that vicinity. The flow varied much in different localities, some wells showing a discharge much greater than others of the same diameter and depth.

From these facts Mr. GAGE concluded that if he could get a tract of land in the right locality he could develop water enough to fill a canal and conduct it to the tract of land adjoining Riverside and irrigate the whole of it. Mr. GAGE then selected a tract southeast of the city of San Bernardino, which bore evidences of being good artesian land, and secured an option to buy this tract within a stated time. He also secured an option on the dry land near the Riverside colony in the same way, and immediately proceeded to sink an artesian well on his water land. The water secured from this experimental well demonstrated that the project was not only feasible but would also prove profitable.

Capital was secured to purchase the lands, develop the water and construct the canal to carry it to Riverside, and the result was the "Gage Canal." Fig. 3 shows a group of the artesian wells at the head of the Gage Canal, which supply the water to fill that canal. There are about 40 wells, and they discharge some 40 cu. ft. of water per second in the aggregate, or 2,000 miner's inches under a 4-in. pressure. The diameters of the casing for the different wells range from 7 to 10 ins., and there are a few which discharge about 2 cu. ft. per second each, while the weakest do not discharge less than ¼ cu. ft. per second. The average discharge is about 1 cu. ft. per second.

The Gage Canal easily has a carrying capacity of 60 cu. ft. of water per second from its head to its terminus, a distance of about 20 miles, and can without great expense be increased to carry at least a third more.

The distance from the water source to the lands irrigated by the canal is about 6 miles, and the additional 14 miles is constructed along the upper side of the tract so that the water may be delivered at any point along the highest border of the land irrigated, which is a strip of territory nearly 15 miles long and about 2 miles wide on the average.

Within this territory are situated some of the finest young citrus colonies in San Bernardino Co.,

such as Lower East Riverside, Hall's addition to Riverside and Arlington Heights, and the whole is a locality which is already famous for its beauty and fertility.

The Gage Canal is an interesting work, as it is constructed in accordance with good engineering practice and shows good judgment in the selection of a route over a very rough and broken country. The notable features about the work are its numerous tunnels and flumes, which are made necessary by the sharpness of the angles made by the side hills, along which it is constructed, and the frequent occurrence of arroyos, both large and small. In many cases tunnels and flumes are appropriately constructed to shorten a route, and, as the elevation of the water source above the higher portions of land to be covered is not great, it was at times necessary to take short cuts to save all the elevation of grade possible.

There are several tunnels and flumes a few miles south of San Bernardino, and several short tunnels near East Riverside. None of the tunnels are long, as in the case of the Jurupa and Riverside canals, not being constructed to pass mesas or mountains, as in the case of the latter, but simply to pass small spurs of the mesas and foothills. All the tunnels are cemented as high up as they are intended to carry water, and are lagged behind the roof timbers. The flume across the Arroyo Seco Chiquito is one of the longest and highest flumes of several others of the same kind. The trestle is erected on abutments of masonry where it is high and on mudsills where it is low, there being no driven piles to support the flume.

The point to be most severely criticised in the Gage Canal is the very light grade on which it is built, something like 1½ or 2 ft. per mile, which in a canal mostly in open earth cutting and of quite irregular and rough cross-section and only intended to carry 60 cu. ft. per second while it is actually supplied with but 40 cu. ft. per second causes the velocity of the water to be so slight that there is only a sluggish current, almost imperceptible to the eye. This, in a climate as sunny and hot as that of Southern California in summer, causes a large amount of the water to be lost by evaporation, and there being very little rain during the dry season the soil through which the canal passes is very parched and dry and there is a still greater loss by percolation. Another objection to the slow current is that it facilitates a more rapid growth of fungi and weeds in the bottom of the canal, necessitating a great deal of labor and expense in maintaining it. The object in giving the canal such a light fall was to bring the water up as high as possible and cover more territory with it. I understand that it is the intention of the Riverside Trust Co., now the owners of the Gage Canal, to rock and cement it in the near future. This will, to a great extent, overcome the objections which have been presented, as the increased smoothness and regularity of the channel will accelerate the velocity.

The Gage Canal is a work which in the main bears evidence of competent professional supervision, and the designing is of a superior order.

THE SOUTH RIVERSIDE PIPE LINES.

These lines have a combined length of about 30 miles, and supply the town-site and acreage property of South Riverside, amounting in all to some 6,000 acres, with domestic and irrigating water. South Riverside is situated southwest of the Riverside colony on a mesa south of the Santa Ana River, in the extreme southwestern part of the great San Bernardino Valley. The soil is mostly a red-clay loam, is considered very fertile, and is adapted to all kinds of fruit.

The water to supply this tract is obtained by collecting the natural flow of a number of small cañons in the Temescal Mountains and developing water by draining cienagas and sinking artesian wells. The methods employed in developing are mostly tunnels and cuts, a few artesian wells having also been bored. There have been developed enough to make, with what water usually flows during the dry season, about 23 cu. ft. per second. The most of this water has been conducted to the tract in a 30-in. cement pipe, having a capacity of delivery of 18 cu. ft. of water per second. This 30-in. pipe is about 9 miles in length, and, being laid over a very rough and broken country, is inclosed at intervals in boxes, erected on trestles across small arroyos and through short tunnels piercing spurs of the hills. Where the pipe is laid through tunnels, about 3,000 ft. in all, it is bedded in and also covered over with sand almost filling the tunnels. The balance of the pipe lines consists of about two miles of 16- and 18-in. cement pipe, and the rest is iron pipe of all sizes up to 13 ins. All except the 30-in. pipe constitutes the distribution system, which is not yet complete, but is constantly receiving additions.

The famous tin mines are situated a few miles up Temescal Creek from South Riverside. Since the sale of the property to an English syndicate extensive developments have been begun, and the company are preparing to work the mines on a large scale in the near future.

One of the first questions to receive attention was that of water supply, and the company have begun the construction of a combined storage reservoir and submerged dam.

They are now engaged in laying the foundation for the structure, which will be built entirely of masonry. The point selected for the site of the reservoir is on the Temescal Wash, where the cañon is quite narrow and the bedrock makes its appearance on both sides of the stream. Pumping machinery has been erected to keep the excavation free from water, which seeps in through the loose sand and gravel of which the creek bed is composed. The foundation is being constructed on bedrock of masonry laid in English Portland cement. It is the intention at present to build a dam 50 or 60 ft. high which will flood an area of several square miles and store water which can be utilized for irrigating, domestic and power purposes.

The New Cape Cod Ship Canal.

The Cape Cod Ship Canal, according to the latest act of incorporation of the many acts, approved June 11, 1891, is to have a capital stock of $5,000,000, and to have authority to issue coupon or registered bonds to a similar amount. The present long list of incorporators is headed by the names of ALFRED D. FOX, CHARLES RIORDON, ROBERT BLISS, JAMES MURRAY, etc., and the official name of the corporation is the Boston, Cape Cod & New York Canal Co.

The line of the canal is broadly laid down as commencing at some convenient point on Buzzards Bay running through the towns of Bourne and Sandwich, and terminating in Barnstable Bay; or the same old location. The incorporators may lay out a canal "not exceeding 1,000 ft. wide"; they must file the location within 6 months from the passage of this act, and complete the canal in 4 years. The Board of Railway Commissioners, and the harbor and land commissioners, are to decide upon the location and manner of crossing of the Old Colony Ry., and the canal company is to build and maintain a combined highway and railway bridge or bridges across the canal, as the joint-commission may decide. The canal company must also establish and maintain suitable ferries free of toll at three points on the canal, and construct highways to connect with these bridges and ferries.

The canal company may establish such toll for vessels passing through the canal as the directors may determine, and also furnish towage for such ships as require it at established rates of toll. The canal company is to pay to the Secretary of the Commonwealth $50,000 on receiving the certificate of incorporation, and also pay for the services of the joint commission and for those of expert engineers required. The canal corporation is not to pay any state or local taxes for five years from the passage of the act, except that the towns of Bourne and Sandwich may tax property taken by the canal until the same is actually dug up and the canal constructed thereon. The present company must reimburse the old Cape Cod Ship Canal Co. for all money expended on land and right of way and assume all liabilities on this account.

All provisions of this act shall be null and void unless the canal company deposits with the Treasurer of the Commonwealth, within 90 days, the sum of $500,000. Of this sum $200,000 shall remain subject to the same trusts and liabilities, to be enforced by the Supreme Judicial Court as the deposits made by the Cape Cod Canal Company, as set forth in Sec. 19, Chap. 359 of the Acts of 1883, and Sec. 4, Chap. 222 of the Acts of 1887; $100,000 is to be forfeited—one tenth to the Commonwealth, one-tenth to the county of Barnstable, and the balance divided between the towns of Bourne and Sandwich according to the amount of land taken from each, unless on or before Jan. 1, 1893, 2,000,000 cu. yds. have been excavated from the body of the canal, and the whole canal finished before June 1, 1895. The sum of $100,000 is to be returned to the canal company when 1,000,000 cu. yds. shall have been excavated from the body of the canal, and another $100,000 when 2,000,000 cu. yds. are excavated; and such sum as remains shall be paid back to the canal company when 3,000,000 cu. yds. are excavated. It is provided, however, that out of this $400,000 the claims, if any, of the Cape Cod Ship Canal and landholders in the town of Bourne are to be satisfied. The act itself is a long one, covering 40 sections.

The Petroleum Trade of Russia.

U. S. Consul CHAMBERS, of Batoum, says that the Russian petroleum trade in 1890 averaged nearly 80,000 barrels per day, as compared with 68,000 barrels daily in 1889. The price of crude oil at the wells in July, 1890, was about 50 cts. per barrel of 42 galls., but much was sold at 35 to 40 cts. per barrel. In February, 1891, four new wells commenced flowing at the rate of 50,000 to 60,000 barrels daily, and the total daily product at that time was about 125,000 barrels per day. This heavy increase in production reduced the price of crude oil to 12 cts. per barrel for spot and 20 cts. per barrel for a year's contract.

On Dec. 31, 1890, there were 238 producing wells; 130 were being drilled and 46 were clearing out and drilling deeper. Refined oil fails to find a purchaser at 3¾ cts. per gallon free on steamer at Satoum, as exporters claim the foreign market is too low even to justify that figure.

The completion of the Suram tunnel, on the Batoum-Baku line, has greatly facilitated railway transportation. The railway company proposes to buy up the 4,000 private tank-cars which formerly were allowed a drawback of about 13 cts. per barrel. They will pay about $625 each for these cars, which cost $1,000 each, or will require the owner not selling to remove his cars from the line within a certain time. This decision is equivalent to advancing the freight rate.

Statistics pertaining to the trade for 1889-90 are thus given:

	Total for year, barrels.
Crude, piped to refineries	27,226,211
Lake oil and crude, piped and shipped by rail	296,422
Used for fuel, and evaporated (estimated)	1,829,865
Stock at wells at end of year	6,837,417
Total	36,189,915
Average daily production, 1890	79,985
" " " 1889	68,341
	Gallons.
Total shipments crude and residuum to foreign countries (1890)	6,282,950
Total to Russia (1890)	657,230
Lubricating oil exported (1890)	19,831,880
" " Russia	677,550
Illuminating oil exported (1890)	24,945,700
" Russia	1,803,915
Refined oil exported (1890)	167,820,695
" Russia	18,236,940
Total shipments to foreign ports (1890)	218,881,225
" " " Russia	21,375,635

An Increase in Pig-Iron Production.

According to the statistics collected by the *Iron Age* another period of great activity in pig-iron production has begun. During the first half of 1891 there was an enormous falling off in the rate of production, due to unsatisfactory market prices and freight rates, and strikes in Alabama and in the Connellsville coke region.

The comparison between production during the first six months of 1891 and the last six months of 1890 is as follows in gross tons, the 1891 figures being approximate:

	July-Dec., 1890.	Jan.-June, 1891.
Charcoal iron	347,406	260,000
Anthracite iron	1,090,702	975,000
Coke iron	3,204,082	2,225,000
Total	4,642,190	3,460,000

Thus the falling off in production has been nearly a million tons in coke iron alone.

But a large proportion of the furnaces which have been idle for more or less of the time during the past six months, are now in full blast. The num-

ber of furnaces in blast and the total weekly capacity on July 1 and on preceding dates was as follows:

		Furnaces in blast.	Capacity per week. Gross tons.
1891	July 1	293	171,115
	April 1	228	113,483
	January 1	302	167,599
1890	October 1	336	179, 63
	July 1	336	175,727
	April 1	344	178,474
	January 1	333	174,038
1889	October 1	311	151,057
	July 1	285	141,419

It appears from this record that the rate of production is approaching the maximum that has ever been attained.

There are still a number of furnaces idle and some new ones which will soon be ready to begin work. Unless the accumulation of stock causes a stoppage, therefore, a further increase in the rate of production may be expected before the close of the year.

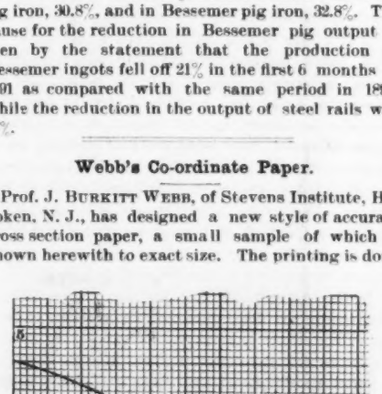
Since the above was written, the *Bulletin* of the American Iron and Steel Association has appeared, giving more exact figures for pig-iron production during the first half of 1891. The total was 3,371,925 gross tons, a decrease of 1,188,588 gross tons or 26% from the production for the first six months of 1890. This falling off in production occurred chiefly in Pennsylvania, Ohio and Illinois; but in all the states whose production is considerable there was more or less falling off. The exact number of tons reduction in output for several states during the first six months of 1891 compared with the first six months of 1890 was as follows:

Pennsylvania, 636,304 net tons; Ohio, 237,568 tons; Illinois, 149,819 tons; Alabama, 84,330 tons; Missouri, 46,634 tons; New York, 44,611 tons; West Virginia, 42,662 tons; Wisconsin, 31,486 tons; Virginia, 25,144 tons; Maryland, 22,640 tons; New Jersey, 20,504 tons, and Kentucky, 6,767 tons.

The chief reduction in production has been in coke pig iron, 30.8%, and in Bessemer pig iron, 32.8%. The cause for the reduction in Bessemer pig output is seen by the statement that the production of Bessemer ingots fell off 21% in the first 6 months of 1891 as compared with the same period in 1890, while the reduction in the output of steel rails was 44%.

Webb's Co-ordinate Paper.

Prof. J. BURKITT WEBB, of Stevens Institute, Hoboken, N. J., has designed a new style of accurate cross section paper, a small sample of which is shown herewith to exact size. The printing is done



Webb's Co-ordinate Paper.

with a non-actinic, olive-colored ink, so that in photographing a drawing the ruling is also photographed, which is not the case with the ordinary cross-section paper printed in light blue. The accompanying cut was made directly from the paper by the photo-engraving process. The paper used is a heavy, wove linen stock with a smooth surface, and it bears erasures well. It is affected but little by ordinary atmospheric changes.

The printing is done from copies of an original plate which was machine-engraved with every precaution to secure accuracy, and the printing plates are renewed from time to time to maintain the absolute sharpness of the lines.

The fifth and tenth lines are made heavier and numbered in both directions from one corner of the paper, with a distinction in the type, so that any point on the paper can be definitely referred to by its co-ordinates. A table of natural tangents is also printed on the margin so that angles can be laid off with ease and accuracy equal to that of an 8-in. metal protractor.

Two sizes of paper are furnished: "large," 17¾ × 11⅝ ins., and "small," 11⅝ × 8¾ ins. The small paper is furnished in sample books containing 20 sheets at $1 each, and can be obtained from Prof. WEBB, or from this office.

PERSONALS.

Mr JAMES K. BROWN has been appointed Village Surveyor of West Troy, N. Y.

Mr. GEORGE G. HALSTEAD died July 20 at Paterson, N. J. He was a civil engineer.

Mr. N. L. DAVIS, Master Mechanic of the Rutland Division of the Central Vermont R. R. Co., died recently.

Mr. W. G. CHOATE has been appointed Superintendent of the Rio Grande Junction Ry. Co., vice Mr. THOMAS SAUNDERS, resigned.

Mr. M. R. Seal has been appointed General Agent, instead of Assistant General Manager, as noted last week, of the Bellaire, Zanesville & Cincinnati R. R., with office at Bellaire, O

NEW PUBLICATIONS.

Report of the Superintendent of the U. S. Coast and Geodetic Survey, 1889. Washington, 1890. Pub. Doc.; pp. 506; 50 maps and charts.

This report is an uncommonly valuable one. Besides the ordinary statistics of progress and expenses, there is much matter of technical interest to surveyors and engineers. Indeed, the greater part of the book is taken up with appendices giving detailed description of methods and instruments used, and general results of the work. Appendix No. 11, containing 170 pages and four supplementary charts, gives magnetic declinations and values for the year 1890 at 3,237 stations in the United States and Canada.

—Interstate Commerce Commission Proceedings.—Relative rates for longer or shorter distances.—In this case a Cincinnati manufacturer complained that he was charged as much for goods shipped to Augusta, Ga., as for goods shipped to Atlanta, some 200 miles shorter distance, and more for goods shipped to Social Circle, a point midway between the two cities, than to either of them. The Commission decides that the greater charge to Social Circle than to Augusta is unlawful. If the railways, on account of water competition, wish to reduce Augusta rates, they may do so, if in so doing they do not discriminate against any "person, company, firm, corporation or locality." A greater charge for a shorter distance, however, is lawful only when the circumstances of the case justify it.

Application for Rehearing.—The Pennsylvania R. R. Co. applied for a rehearing of the case in which rates on fruit from the peach-growing districts to Boston were fixed by the Commission, claiming that its connecting lines were demanding the lion's share of the rate, basing their demand on the argument of the Commission. The Commission refused to rehear the case and virtually told the railways to settle the quarrel among themselves.

—Engineering Association of the South: Selections from Papers Presented During the First Fiscal Year.—Nashville, 1891. 6 × 9 ins., pp. 51.

The half dozen papers contained in this first volume of our youngest engineering society's proceedings were presented between Nov. 21, 1889, and Nov. 13, 1890, and are consequently a little out of date now. We may say, however, that much older and larger and richer engineering societies have not always published the papers read before them until they had grown slightly moldy. The papers of most interest in the volume are a very good one by Mr. R. L. ENGLE on the Louisville & Jeffersonville bridge, and a description of Coke Making in Western Kentucky by Mr. JNO. B. ATKINSON.

We have also received the list of officers and members of various grades of the association, from which we learn that this young society has now 90 members, 4 associates and 10 juniors. Of these, 26 are in Kentucky and 48 in Tennessee, which indicates that the society has plenty of room to grow up to its name. Copies of either of the above volumes can probably be obtained from the Secretary, Prof. OLIN B. LANDRETH, Nashville, Tenn.

—American Forestry Association—Proceedings of summer and annual meeting, 1890. Washington, D. C. Paper, 6 × 9 ins.; pp. 111.

This book contains the reports of committees and the papers read at the meeting, including an interesting one by Mr. B. E. FERNOW upon "The Forest as a National Resource."

—Report of Eleventh Annual Meeting of the American Water-Works Association, at Philadelphia, 1891. Published by the Association. J. M. DIVEN, Elmira, N. Y., President; J. H. DECKER, 86 Liberty St., New York, Secretary. Pamph., pp. 224. Illustrated. Price, 50 cents.

A full report of the above-named meeting appeared in our issues of April 18 and 25, 1891, and therefore an extended notice is unnecessary.

—General Specifications for Grading and Building Earth Roads.—Paper, pp. 8.

Reprinted from "Engineering Specifications and Contracts," by L. M. HAUPT.

—H. M. S. Victory.—Her history and construction. Paper, 7½ × 9¾ ins.; pp. 38; illustrated. Reprinted from *The Engineer*, London, England.

This is a description of the celebrated frigate *Victory*, on board of which Admiral NELSON died, and a model of which is now at the Naval Exhibition in London.

—Some of the Functions of the Locomotive. H. A. LUTTGENS, Paterson, N. J. Paper, 4 × 5¼ ins.; pp 19.

This little pamphlet deals with the firing of locomotives, showing the special advantages of the LUTTGENS smoke-stack damper, and giving testimonials of the use of this device.

TRADE PUBLICATIONS

—Track Equipment.—New York Equipment Co.

A table printed on a celluloid card 6½ × 8 ins., giving the quantity and weight of material required for track with different weights of rails.

—Construction and Use of Universal and Plain Grinding Machines.—Providence, 1891, Brown & Sharpe Mfg. Co. 6 × 9 ins., pp. 147.—Illustrated.

This book is quite an improvement over the last one on this subject published by this house. The former edition described but three styles of machines, while this describes five. The most valuable portion of the work, that relating to the care and use of grinding machines, the selection of emery wheels, etc., has been much enlarged, and is really a valuable guide for those inexperienced in the use of grinding machinery, and may be also of use to some whose experience with these machines has not taught them how to secure the best results from their use.

—Hewling's Directory of Steam Specialties and Engineering Appliances.—Chicago, 1891. A. J. Hewlings. Cloth, 4 × 7 ins.; pp. 242. $1.

A good trade directory is a scarce article. Their compilation is a difficult task, and the compiler generally tries to cover up his omissions and failures by stuffing his list with the names of firms and dealers long since bankrupt, or out of business for other reasons, or who never did anything beyond exciting great expectations. Changes in business are rapid in these days, and any directory soon gets behind the times. We have looked over this little volume quite carefully, however, and are inclined to give the compiler much praise for careful and conscientious work. We find evidence that he has taken pains to exclude names of defunct firms or firms whose connection with the specialty named is exceedingly remote. On the other hand, he has certainly tried to make his lists complete and omit no live firms; and his success has been really remarkable. It is explained, however, by the fact that he is well acquainted with the steam specialty trade and was able to secure names of live firms and omit those of dead ones, which a less experienced compiler could not have done.

SOCIETY PROCEEDINGS.

New York Railroad Club.—No meetings will be held during July and August. The first fall meeting will be held on the third Thursday in September.

The American Institute of Mining Engineers will hold its 60th meeting at Glen Summit, Luzerne Co., Pa., beginning Oct. 6. Fuller particulars will follow, but special discussions are expected on the preparation and utilization of small sizes of anthracite and the practicable uses of concentrated iron ores.

The Civil Engineers' Club of Cleveland.—Meeting of July 14th. Pres't Gobeille in the chair and 32 members and several visitors present. After some discussion the following resolution by Mr. J. L. Culley was unanimously adopted: "*Resolved*, That this club heartily indorses the action of the general committee of Engineering Societies, Columbian Exposition, so far as the work has progressed, and that we are in full sympathy with the work as set forth in the report of our representatives." Mr. James Ritchie read a paper describing a design for a built-plate girder to span a 60-ft. store front and carry the floors above of a heavily loaded building. The depth of the girder is the height of the second story and has openings in the web so that ordinary windows are not interfered with. The main difficulty is the transmission of shear on account of the web being interrupted by the window openings. This is overcome by forming the bottom flange partly of a 42-in. plate securely riveted at the pilasters, so that the load concentrated there is transmitted through the rivets and the 42-in. plate as if the latter were the full depth of web. In the absence of Mr. E. H. Jones, the secretary read a paper by that gentleman on the recent Providence meeting of the American Society of Mechanical Engineers. It contained many interesting and instructive points from the papers read at that meeting.

WM. T. BLUNT, Sec. pro tem.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXVI. Saturday, July 25, 1891.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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July 4, 1891.

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COMING TECHNICAL MEETINGS.

American Society of Swedish Engineers.—Aug. 1. At 250 Union St., Brooklyn, and 847 North 9th St., Philadelphia.
Civil Engineers' Society of St. Paul.—Aug. 3. Secy., C. L. Annan.
Western Society of Engineers.—Aug. 5. Secy., J. W. Weston, 239 La Salle St., Chicago.
Engineers' Club of St. Louis.—Aug. 5. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.
Engineers' Club of Minneapolis.—Aug. 6. Rooms, Public Library Bldg. Secy., F. W. Cappelen.
Association of Civil Engineers of Dallas.—Aug. 7. Secy., E. K. Smoot, 803 Commerce St.
Technical Society of the Pacific Coast.—Aug. 7. Secy., O. von Geldern, 819 Market St., San Francisco.
Engineers' Club of Kansas City.—Aug. 10. Rooms, Baird Building. Secy., H. Goldmark.
Atlanta Society of Civil Engineers.—Aug. 11. Secy., Parker N. Black, 39 Capitol Block.
Civil Engineers' Club of Cleveland.—Aug. 11. Secy. A. H. Porter, 50 Euclid Ave.
Denver Society of Civil Engineers.—Aug. 11. "Sewer Construction." Secy., Geo. H. Angell.
Civil Engineers' Association of Kansas.—Aug. 12. Secy., J. C. Herring, Wichita, Kas.
Engineers' Society of Western Pennsylvania.—Aug. 18. Secy., J. H. Harlow, Pittsburg, Pa.
Engineers' Club of Cincinnati.—Aug. 20. Secy., J. F. Wilson.
Scandinavian Engineering Society of Chicago.—Aug. 20. Secy., T. G. Philfeldt, 113 Adams St.

THE New York Rapid Transit Commission has settled upon an east side route as far as the Harlem River only; surveys now in progress will be required to determine a location above that point in the Twenty-third Ward. The detail of the route is given elsewhere. The line selected is a good one; but it is to be regretted that financial reasons mainly have prevented the extension of this second route further down town than Union Square. While we can understand that to make this system as complete as it should be an almost prohibitory sum of money is required, it is below Fourteenth St. where the mass of passengers to use these lines will be found. More than one line must eventually extend to the City Hall, at least, and whether built at once or not, it should be included in any complete system proposed. But that can come later. We do not see the necessity of another east side line, by way of Third Avenue and the Bowery, as suggested by some of the papers of this city. From 23d St. to the Harlem River the strip east of this last Madison Avenue route is nowhere one mile wide, and through the middle of this strip the Third and Second Avenue Elevated lines give abundant service. A loop line along 14th St. to Columbia Avenue and down the East River front to the City Hall by way of East Broadway, might eventually be of some use in opening up a section now rather remote from any rapid transit lines.

One of the interesting features brought out by this investigation is the fact, already well known to many promoters of suburban real estate, that between the Harlem River and the New York and Northern Railway there is a strip of beautiful, undulating country, about six miles long and one mile and a quarter wide. In all this territory, though within the limits of the city of New York, there are only about one dozen farm-houses, and the land suitable for this purpose is utilized as farm land alone. It is not necessary to dilate upon the rapid changes that would take place in this particular section were a rapid transit route to be laid down through it. It would be the story of the west side of Central Park over again; and the gain in taxes from this improved property would fully warrant its development. Unfortunately, the present Rapid Transit Commission is limited in its powers to a study of elevated and underground railways, and cannot deal with surface road construction, which would most quickly and economically meet the wants of this region.

THE article on the phosphate deposits of Florida, published elsewhere in this issue, gives some interesting particulars of this new industry which has caused such a fever of speculation in that state during the past two years. It may be taken as fairly well proved that Florida is destined to be the source of a considerable part of the world's phosphate supply for many years to come. But it does not at all follow from this that every owner of phosphate lands or every mining company formed to develop them is going to get rich, or indeed achieve any success at all. The prominent characteristic of the Florida phosphates seems to be their irregularity and uncertainty. Professor DARTON says: "The deposits are exceedingly irregular in extent and richness; and while there are many areas underlaid by large bodies of high grade mineral, the great number of the deposits consist of impure, thin or scattered beds of no economic value."

Dr. FRANCIS WYATT speaks in the same way: "The Florida land phosphates of high grade occur in beds of an essentially pockety, extremely capricious, uneven and deceptive nature."

The moral of this is that the investor in phosphate mining will be just as likely to exchange his money for experience, if he invests without careful investigation and considerable knowledge, as the investor in some other mining industries, perhaps a little more likely.

And the statistics quoted elsewhere, while doubtless much exaggerated, show that even the companies which are so fortunate as to control a deposit of high-grade marketable rock may not find it all clear sailing toward big dividends. There is a great deal of good phosphate in Florida, and it is being rapidly developed. It is not impossible that the supply may increase faster than the demand, and the consequence will be the collapse of prices, followed perhaps by the collapse of some of the weaker companies in the business.

Of course the field for commercial fertilizers is rapidly growing and with it the demand for phosphate rock. For this reason the discovery of the Florida deposits is a real blessing to the world, and it is greatly to be hoped that they may prove as inexhaustible as has been claimed. But the world doesn't need them all in the next year, or two years, or ten years; and it will be best for all parties concerned if the producers of Florida go ahead no faster than the market demands will warrant. A factor of no small importance in estimating this demand, by the way, is the rapidly increasing production of basic steel, the slag from which is one of the most important sources of phosphate of lime, and is largely used by fertilizer manufacturers in Europe.

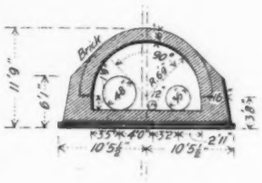
ENGLISH engineers are much exercised over the discovery of a paradox in steam engineering, for which no satisfactory explanation seems to exist. Feed-water heaters using exhaust steam or waste flue gases as a source of heat are common everywhere; but an inventive Englishman has hit upon the new idea of heating the feed water up to the full boiler temperature by live steam from the boiler before pumping it into the boiler. At first sight this looks like robbing Peter to pay Paul: and the inventor, indeed, claims to have had no expectation of increasing the fuel economy by his device, but only of reducing the internal strains on the boiler due to the entrance of cold feed water. But to the astonishment of all parties concerned, a marked and positive saving in fuel and a gain in the capacity of the boilers to furnish steam have followed the use of this heater.

In the last issue of *The Engineer* some tests of this heater are described, and there seems to be no room for doubt as to their accuracy. It now remains to find the reason why the heating surface of a boiler should absorb heat from a fire more rapidly when evaporating water at a temperature of over 300° than when heating water from ordinary feed-water temperatures to the boiling point corresponding to the steam pressure. The explanation given by *The Engineer* in the editorial which we reprint elsewhere is about as confused and unsatisfactory as its report of the tests made is clear and convincing. The point made as to keeping grease out of the boilers is a good one, but does not at all explain the tests recorded, in which the heater was put in and out of use at intervals of less than an hour. Our contemporary makes a worse error when it says:

> Each unit of heating surface will probably in a given time transmit about the same quantity of heat, whether the water in contact with it is 200° or 350° or even hotter.

Now, as a matter of fact, what the tests reported by *The Engineer*, indisputably proved, was that a considerably greater quantity of heat was transmitted in a given time by the boiler heating surface when the feed water was heated by live steam from the boiler in the separate heater than when it was pumped directly into the boiler. It seems certain, too, that this increased efficiency of the heating surface was due to the fact that it was all at work generating steam instead of heating water to the boiling point in certain parts.

If it be true that heating surface works more efficiently when evaporating water than when



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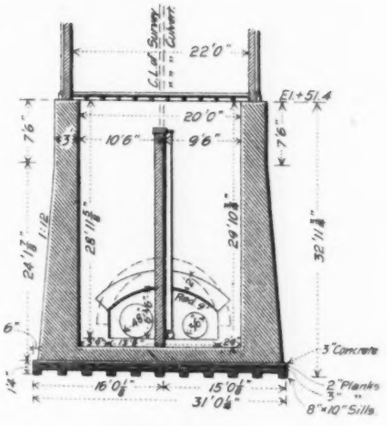

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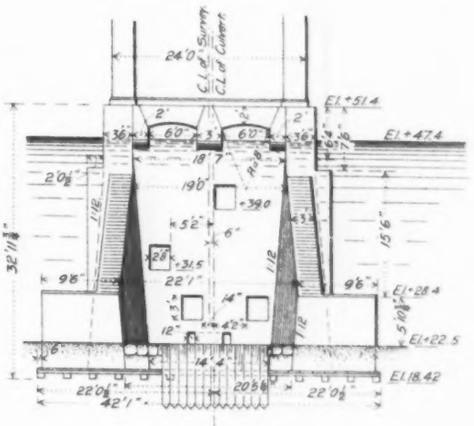

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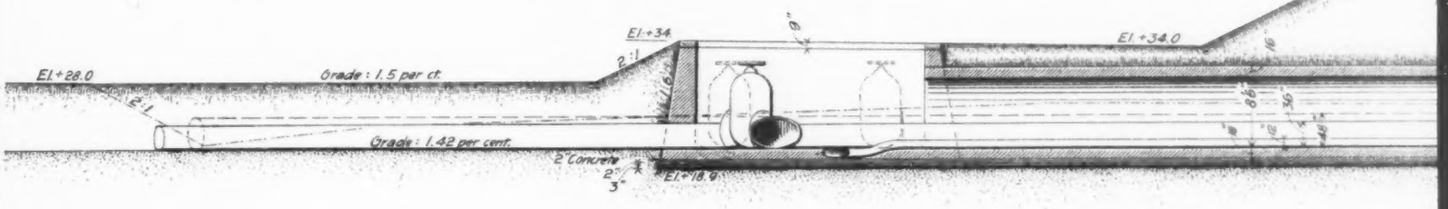
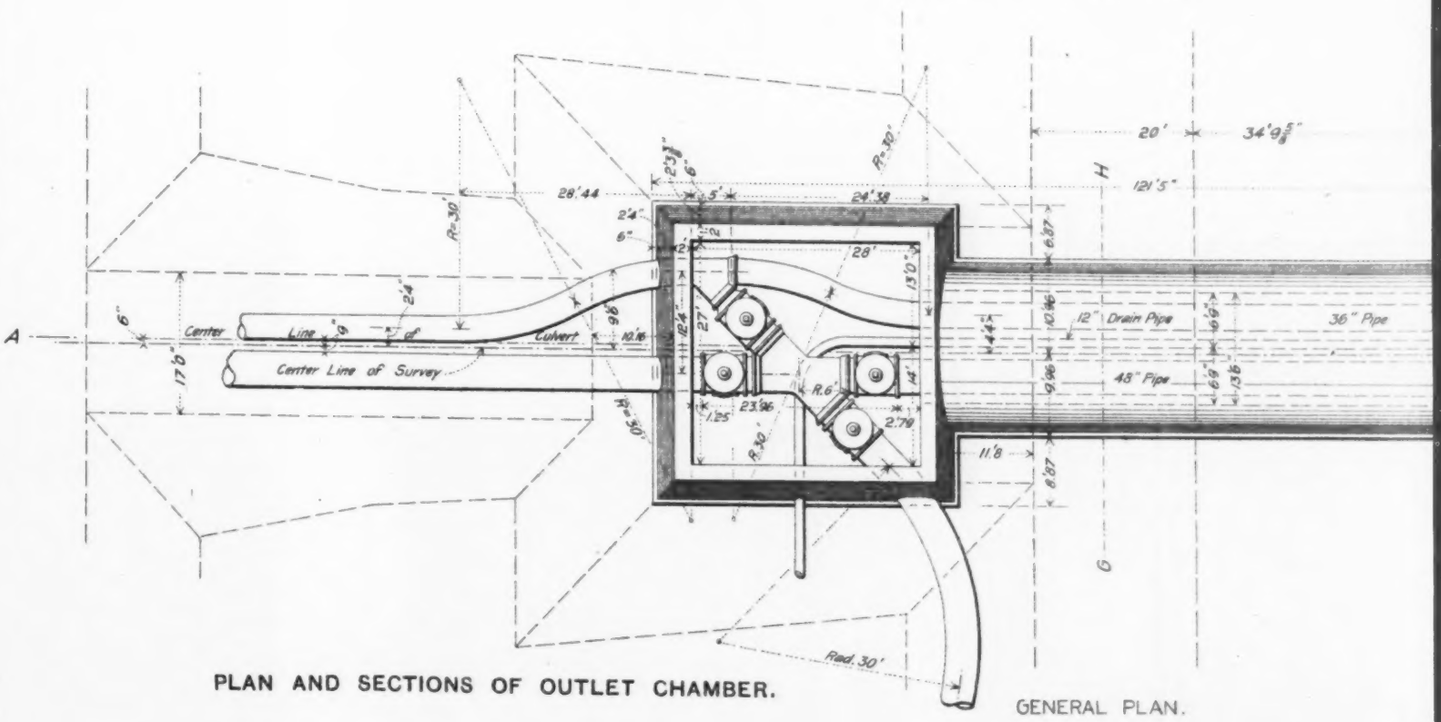


LONGITUDINAL SECTION A-B.



PLAN AND SECTIONS OF OUTLET CHAMBER.

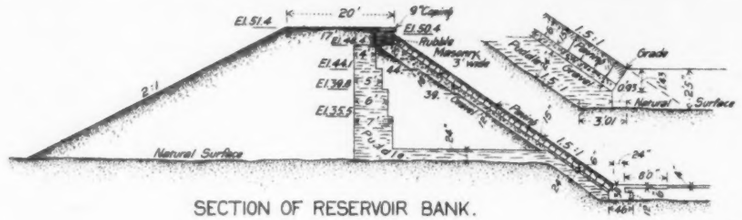
GENERAL PLAN.

THE BROOKLYN WA

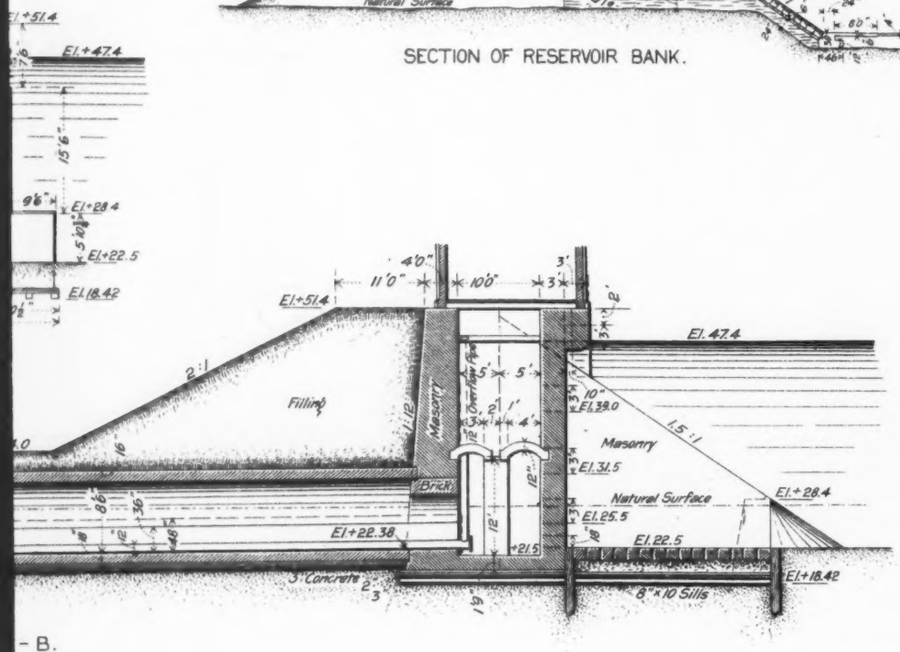
BALDWIN STO

ROBERT VAN BUREN, CHIEF ENGINEER.

JOHN P. ADAMS, Co



SECTION OF RESERVOIR BANK.



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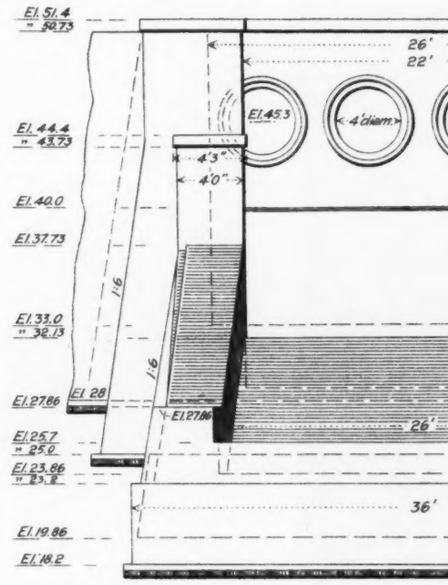

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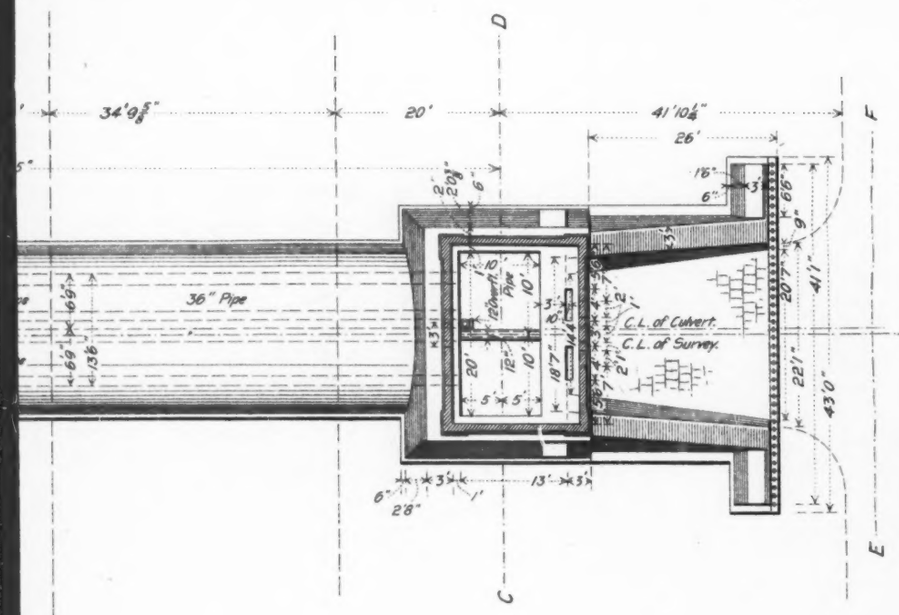

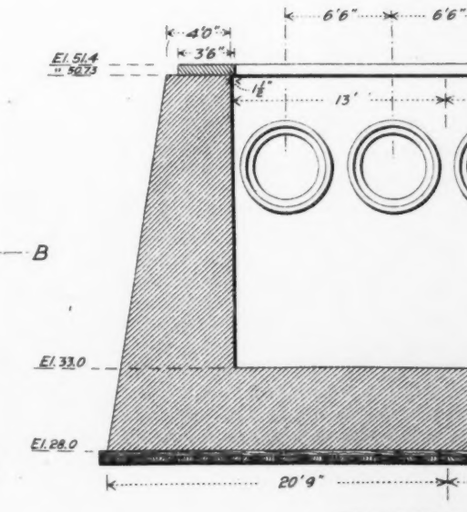

TRANSVERSE

N.

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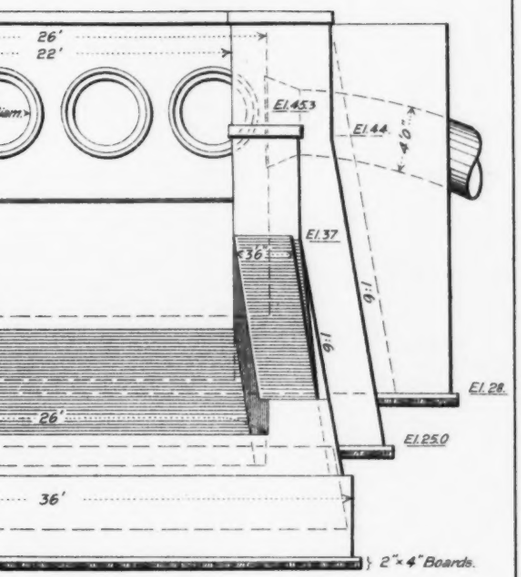
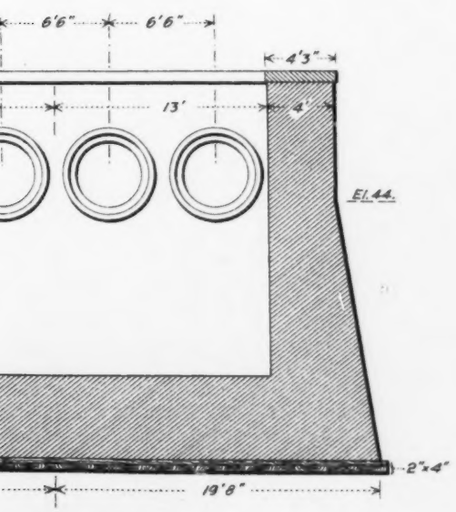
BROOKLYN. WATER-WORKS EXTENSION.

BALDWIN STORAGE RESERVOIR.

JOHN P. ADAMS, COMMISSIONER OF CITY WORKS. I. M. DE VARONA, ENGINEER IN CHARGE.



ELEVATION.



SVERSE SECTION.

ECTION OF INLET CHAMBER.

LITH. CHAS. HART & SONS, 90 VESEY ST., N. Y.

heating it, we have an explanation of certain facts hitherto little understood. The feed-water in a firebox boiler—the locomotive, for instance—is always pumped in at the front end, at the point farthest removed from the most efficient heating surface. The long time required to heat boilers up to working pressure and the strains and leaks which then occur may be due to the slower transmission of heat as well as to the other well-known cause, unequal expansion.

Why heating surface should be more efficient when the water in contact with it is boiling, we can only conjecture. The most probable cause seems to be the motion which is set up as soon as the steam bubbles begin to form, violently agitating the water, and bringing fresh currents constantly against the hot plate. It is well known that the efficiency of heating surface is enormously increased when the water is moved over it at considerable velocity; and this may be the explanation of the seeming paradox described above.

THE bursting of a 6-in. breech-loading gun on the H. M. S. *Cordelia*, on June 29, has led to a renewal of unfavorable criticism of the present system of built-up steel guns, for which contracts to a large amount were practically let by our own government this month. But among the ordnance officers of both the Army and the Navy of the United States these criticisms have no weight. In the first place, it is now concluded by British officials, though the record seems to be somewhat mixed, that the failing gun on the *Cordelia* was of an early and weak pattern, of which there are still about 101 in use out of a total of 530 6-in. guns of various types in service. Many of these English guns represent a transition stage in passing from the old wrought-iron gun to the all-steel construction of the present day, and English authorities admit that in the later tendency to increased charges and greater muzzle energy these guns may be overstrained. Our own guns have been made entirely of steel from the beginning, from ingots manufactured under specifications and inspection that were at first termed prohibitory by our manufacturers, and were so until they improved their methods to meet them. Our processes of manufacture and the tools employed have called out the unqualified commendation of the highest English ordnance authorities; and lastly, the guns we have made have withstood the severest service tests, and so far without failure. The first breech-loading 6-in. steel rifle made by the Navy Department at Washington was put on board the *Dolphin*, after it had passed through the most thorough tests. Since then it has been fired more than 300 times with full service charges without showing any symptom of weakness. Our officers claim that the 6-in. guns on the *Chicago*, *Boston* and *Atlanta* are fully 40 per cent. stronger than the English type of gun used on the cruiser *Cordelia;* and that, moreover, while the English still adhere to the violent black powder called "pebble," our guns use the new "brown powder," which gives high velocity with a minimum of strain on the breech of the gun. This later powder, it is claimed, adds another 10 to 20 per cent. to the safety conditions of American all-steel built-up guns; and it can thus be safely concluded that our guns are fully up to, if they do not surpass in some essential features, the very latest types of foreign manufacture.

In connection with the later types of steel breech-loading gun, with its very long bore and comparative thinness at the muzzle, *The Engineer*, of London, in discussing the bursting of the gun on the *Cordelia*, says that that accident reads like the case of a shell wedging in the bore. While this may or may not explain this particular accident, and the fragments of this gun were hurled "hundreds of yards into the sea" and can never be recovered to be used in evidence, this wedging accident is one for which no modern gun is to blame. The projectile may be at fault; and if this yields in the gun in any way under the explosion of a powder-charge which equals half the weight of the projectile, something is bound to give way, and the point of rupture will be in the breech of the gun, where it will do the maximum damage to the gun's crew and the ship. For this reason the care now taken by our Army and Navy authorities in securing perfect and proper projectiles is as commendable as their efficient efforts to improve the manufacture of the gun itself. Few outside of Army and Navy circles realize what changes have taken place in our own ordnance since as late a date as 1884. In that year the 100-pounder M. L. R. gun weighed 4.3 tons, had a length of about 154 ins., fired a projectile of 100 lbs. with 10 lbs. of powder, and had a muzzle energy of 809 ft. tons. The modern 6-in. B. L. R. gun weighs 4.9 tons, has a length of 196 ins., and uses 50 lbs. of powder with a 100-lb. projectile, with a resulting muzzle velocity of 2,000 ft. secs. and a total energy of 2,774 ft. tons. This exceeds the latest English gun of the same type, which uses 42 lbs. of powder for a 100-lb. projectile and develops an energy of 2,665 ft. tons. The weight of the English gun is about the same. But the increase of the powder charge in these guns, from 1-10 to 1-2 the weight of projectile, is the particular feature that calls for excessive care in the form and quality of the projectile used. If all goes well, the resultant effect is a projectile delivered with an enormous energy. But if the shell breaks or a fragment wedges it fast in the bore, the powder burns just the same, the gas is generated in a confined space, and its enormous pressure is then exerted in rending the breech of the gun, and only abnormal proportions will make the gun secure against this faulty projectile.

ANOTHER feature that may account for the inferiority of at least some of these English built-up steel guns is that the material used at Elswich is made by a process that reduces the cost about one-half as compared with the steel used by Krupp and Schneider, and there is a live suspicion that the quality of the metal is reduced, if not in proportion, at least to a material extent. The cost per ton of finished gun for the 111 and 119-ton gun is thus set down by the U. S. Bureau of Naval Intelligence for June, 1890:

Maker.	Weight of gun	Total cost.	Cost per ton.
Armstrong, 16¼ ins....	111 tons.	$93,160	$839 28
Krupp, 15¾ ins	119 tons.	144,750	1,216.38
U. S. Navy, 12 ins.....	46 tons.	61 846	1,344.78

The last-named gun, of much smaller calibre, is the only United States gun we can compare with the above, and the price is taken from the bid of July 13 of the Bethlehem Iron Co. for 24 service guns of this type. This price is interesting as showing that though so recent an industry in this country, the ton price for guns is approaching that of one of the best European makers, even though this price is for a gun of so much smaller weight. In the comparison made by the naval intelligence bureau, the powder charge of the Armstrong gun is put down at 960 lbs. for an 1800-lb. projectile, and 727.5 lbs. for a 2028-lb. in the Krupp gun. The result is a chamber pressure of 19.5 for the English gun and 14.7 for the German gun. In this connection Admiral THOMAS SYMONDS, of the English Navy, is authority for saying that one of these Armstrong 111-ton guns has a total endurance of only 96 service rounds; while at least one of the 119-ton guns made for the Italian Government by Krupp has been fired 200 times and is still fit for service. Whether this inferiority in service is due to the excessive work demanded and to unusually great erosion of the bore, or to less perfect metal and workmanship, is a question we can not settle. But if this same cheapening process is carried into the manufacture of the smaller guns—and it must be, for it would never have been tried on the heavy guns first—the class of metal used and the methods of manufacture may have had something to do with the failure of the gun on the *Cordelia*.

ACCORDING to *The Critic*, of Louisville, Ky., that city, of more than 160,000 inhabitants, is saddled just now with a City Engineer that is sorely lacking in essential fitness for office. It seems that in a trial now in progress concerning the responsibility of the city of Louisville in connection with a street-paving contract the competence of the City Engineer was brought into question. The attorney for the contractor proceeded to examine the engineer in the rudiments of mathematics, and this individual was either the subject of a bad case of "stage fright," or he was put into office for other qualifications than engineering knowledge. A straight line, according to his light, was one he supposed "would run without interference as to its course." A right-angled triangle "lies at right angles to the other," and just what an isosceles triangle was he honestly confessed he did not know. But the climax was reached when, after defining a hexagon and an octagon as "six- and eight-cornered articles," he declared that "a paragon" was an "eight-cornered instrument." It is unnecessary to follow this shameful exhibit of ignorance further, except to mention that this "engineer" deemed that his full duty in superintending street paving ended when he was satisfied that the "asphalt was put on of the proper thickness."

It is difficult to realize that a prominent city, the engineering affairs of which were long under the control of competent engineers, should be so thoroughly handed over to short-sighted political power as is indicated in this appointment. Who this "engineer" is we do not know, never having before heard of him. While we can conceive of certain rudimentary mathematical problems that it might puzzle even an engineer for a time to answer in exact geometrical terms, he should at least know what was meant by the question and in his own language express his meaning clearly. Assuming that this trial was fairly reported in the paper quoted—and there seems to be no reason to doubt this—we have here but another instance of the subversion of an engineering office to purely political and personal aims. We do not blame this particular "engineer" for accepting an office for which he was not fitted, so much as we condemn the authorities who are so lost to a sense of the fitness of things and hold the fair fame and honest needs of their city so lightly as to appoint him.

A British Criticism on American Bridge Practice.

Elsewhere in this issue we reprint an article from an English exchange in which the writer, Mr. MAX AM ENDE, describes a bridge designed by him for a Brazilian railway. As the bridge was to be built in England and shipped to the place of erection, the American system of pin-connections was adopted instead of the riveted type of structure generally favored by English engineers. But although the writer adopted the American type of bridge, he thought best to make a few improvements in it, and these he lucidly describes in the paper reprinted elsewhere, explaining at the same time the faults of American practice which his improvements are intended to overcome.

Since he is so ready to criticise American practice he will probably not object to having his own designs criticised. As a matter of curiosity we would like to know at what date the writer ob-

tained his knowledge of American bridge building. Surely it cannot be within seven or eight years, for he has adopted the now almost discarded Whipple truss, and has made his panels only 14 ft. in length, shorter even than those that were in vogue here a dozen years ago. Again, his truss depth of 19 ft. 6 ins. is altogether too small for an economical design. This is proven by his weight of metal, which is 896 lbs. per lineal foot, while a bridge of the same capacity and *strength*, but with better details, as designed by an American engineer, would weigh only 800 lbs. per lineal foot.

The ruling dimensions and features of such a bridge would be as follows: Number of panels, 7; truss depth, 28 to 30 ft.; single intersection with parallel chords; deep floor beams and stringers; and stiffened bottom chords in four out of the seven panels. A saving of 12 per cent. in the total weight of metal by the adoption of a superior design is an item of quite a little importance.

Now, as to Mr. MAX AM ENDE'S so-called improvements on American practice:

1. *Stiffened Bottom Chords.*—We would state that it is customary in this country to stiffen bottom chords wherever there is a possibility of reversion of stress, and that in the case under consideration the two panels nearest the ends of the span would have their bottom chords stiffened. Stiffening the remaining three panels might add a trifle to the rigidity of the bridge but would not increase its strength or durability, unless the wind pressure specified were excessive.

2. *Hinges at Hips.*—The best practice here until lately has been to make perfect hinges at hips by leaving a small space between ends of channels; but of late it has been found that abutting ends give quite as satisfactory results.

3. *Location of Overhead Bracing at Ends of Span.*—We consider that (Mr. MAX AM ENDE to the contrary notwithstanding) the proper place for such bracing is between the inclined end posts, as the direction of travel of the wind-loads to the piers thereby is more direct than it would be through the hip verticals and bottom chords; and the American method of designing this bracing by no means interferes with the movability of the inclined end posts on the pins.

4. *Stiff Lateral Bracing.*—This is used more or less in modern American bridges, especially important ones.

Now that we have reviewed Mr. MAX AM ENDE'S so-called improvements on American practice, let us glance at his own details, and see if some of them be not defective.

The reduction in depth of stringer from 19½ ins. to about 8½ ins., where it rests on the masonry, cannot surely be called good practice, even if there be enough sectional area in the reduced web to take up the vertical shear, because, first, of the difficulty in getting enough rivets in such a short space as eight or ten inches to take up the horizontal shear; and, second, on account of the weak point in the beam at the bend, as demonstrated by BOLLER'S experiment upon a full-sized beam.

The fish-belly shape of the hip vertical is, to say the least, unsightly. It is in violation of a principle always observed in good practice, that wherever practicable, sections of all members are to be symmetrical or balanced.

Again, the lacing bars used have by far too much spread to be effective; and the eye-bars with heads riveted on indicate rather crude shop practice.

If we could inspect the working drawings instead of the very small scale details of the illustration, we might be able to criticise further. However, we have indicated enough to show that Mr. MAX AM ENDE would have done much better if he had come to America to study modern methods of bridge building before attempting to improve on the practice of American engineers.

It is encouraging, however, to see one English engineer willing to recognize the superiority of the American type over the English for ease of erection and willing to risk his reputation by designing a pin-connected bridge, even though he did consider it necessary to tack on some improvements of his own.

Since the above was written the July number of the journal above noted has appeared, and in it we find another article by Mr. MAX AM ENDE, in which he discusses the relative superiority of pin and rivet connections for bridges; and, notwithstanding his Brazilian pin-connected structure noted above, endeavors to prove that the riveted structure is the superior.

We do not reproduce the article, as its length is considerable, and its importance does not seem to warrant a very extended study by American bridge designers. The above examination of the pin-connected bridge designed by Mr. AM ENDE does not tend to increase one's confidence in his ability to discuss the relative merits of pin and rivet connections, especially as one of his methods of proving the riveted bridge's superiority is by making typical designs for each system and then comparing their weights.

We will, however, give our readers an idea of some of the chief points which Mr. AM ENDE endeavors to make. We quote the following extracts from the first part of his article:

As the axes of all the pins are at right angles to the plane of the main girder, their fitness for the junction of parts which transmit forces acting in that plane is unquestionable; but in a bridge, forces also occur which act in planes at right angles with the plane of the main girder, viz., in vertical, horizontal and inclined planes; and for the junction of the frames transmitting these forces the same pins are not suitable. In bridges with overhead bracing there are at least two horizontal frames and the inclined frames at the ends, each with their flanges and webs; and in bridges without overhead bracing there is one horizontal frame and a number of vertical frames. Now, if in American bridges the flanges or the verticals of the main girder are to be used as parts of these frames, it is found that either the pins must be used for attachments, for which they are not suited, or they must be avoided, with the result that the parts of the main girders intended to be used are not in the proper position. It is conceivable to attach a frame at right angles with the main girder in the proper position if two pins were used in place of one, or two frames, for example, a vertical and a horizontal frame, if four pins are used, but this would lead directly to the use of rivets in place of pins.

The importance of connecting the transverse frames with the main girders in such a manner that all the strain lines or any fork-shaped division of them are inclosed from end to end in solid metal seems not to have been sufficiently appreciated formerly, as in many examples these lines pass through space not filled with metal. A certain want of rigidity, which is said to be peculiar to pin bridges, is probably attributable to this cause, and not so much to the pin connections themselves, for although the inaccuracy in the length of a number of eye-bars fixed by the same pin has in some cases been so great that they clatter under a passing load, modern practice is generally free from such faults. If the transverse frames are made to fulfil, the condition named above, either in the manner shown in the previous article or by the introduction of outer platform stringers, although new difficulties arise here in the form of horizontal bending strains in the cross girders, there is no reason why a pin bridge should not be as rigid as a riveted bridge with regard to the transverse actions to which it is exposed.

The meat in this, as nearly as we can make out, is that in the first place pin connections "are not suitable" for joining the upper and lower lateral bracing to the main trusses; and in the second place, "if all the strain lines or any fork-shaped division of them are inclosed from end to end in solid metal . . . there is no reason why a pin bridge should not be as rigid as a riveted bridge to sustain transverse strains." Just what idea the author means to convey by "inclosing in solid metal all the strain lines or any of their fork-shaped divisions," we do not know; but we fully agree with his conclusion that there is no reason why a pin bridge should not be made as rigid as a riveted bridge to sustain transverse stress.

The author then describes the system of construction used by GERBER, of Bavaria, in which a riveted connection for the horizontal bracing is made with the upper and lower chords, in some manner not very clear. Mr. AM ENDE says:

From the point of view of theoretical exigency GERBER'S system of connections is much more penetrating than the American system, and some features of it are excellent, but from a practical point of view it appears too complicated.

This, then, is one fault of the American system of connections. They are not "penetrating" enough. What the author means by "penetrating" in this connection is, we must confess, entirely beyond us.

But passing on to the author's main argument, it is necessary to take up only a few points to show that the trouble with Mr. AM ENDE is that he is unfamiliar with American methods of construction. He attempts to show, first, that "the certainty of attaining the required strength of connections" is as great in riveted as in pin bridges, as follows:

This is a question of accuracy of workmanship. The accurate boring of a pin hole and the turning of a pin are operations as easy as the accurate drilling of a group of rivet holes with a good templet; a difficulty arises in making a number of parts of equal length between the pin holes and the difficulty is the same with regard to groups of rivet holes. In the latter case an additional difficulty is the avoidance of an angular discrepancy between two corresponding groups in parts which form an angle with each other, such as flanges and diagonals. Upon this may be remarked that pins generally pass through a number of parts of great aggregate thickness, and that it is difficult to fix them unless they are made smaller than the holes. Great accuracy of fitting is therefore difficult to attain; whereas rivets generally only pass through a few plates of moderate thickness, lying close together, and, as they swell, when properly driven in, the accuracy of the holes need not be so great. The control and inspection of the rivet holes is also easier, because in a bridge erected in the yard with service bolts all holes are or can be made visible. If they are then rimered to the same size, and if only one size of rivets is supplied to the erector, there is every inducement on his part to make the groups of holes coincide. If this is done by the use of drifts, and initial strains are set up in the structure, such strains are only comparable to those produced by the ramming in of pins with heavy swinging weights. Summing up this part of the subject, it may be said that riveted connections can be and in fact are made with the same accuracy and of the same strength as pin connections; yet when the bridge has left the factory more uncertainty prevails in the case of the riveted bridge, because more supervision is required to prevent the insertion of inefficient rivets. No pin bridge, however, is quite free from riveted connections; and although their number is less, it cannot be asserted that they are of no importance.

According to this, the usual method of constructing a riveted truss is to drill all holes with a "good template," then erect the bridge in the yard with "service bolts," and ream all holes to a common size, then take down the structure and erect it at whatever place it is designed for. If this is a fair statement of the ordinary methods of English bridge shops, it is not strange that English bridges "come high."

As for the author's description of American methods of construction and erection, he is evidently unaware that the machines used in forming and boring eye-bars have reduced inaccuracy in the length of eye-bars to an exceedingly small limit, and that, too, in ordinary practice. Concerning the driving in of pins by heavy swinging weights: as the author says, it is difficult to fix the pins in the plates unless they are smaller than the holes. We would respectfully add that it is practically impossible, and that such driving in of pins as is done does not cause any loss of strength in the eye-bars at all comparable with those produced in a riveted plate by the use of the drift pin. Pins are not turned and holes drilled in any hap-hazard way. Specifications generally limit the amount by which the pin may be smaller than the hole; and the bridge builder, who may have to erect his bridge a thousand miles or more from the shop, will see to it that no pin too large for its eye-bar goes out to the work, where it might cause a week's delay and very great loss.

The highly accurate knowledge which Mr. AM ENDE possesses of American bridge shop practice may be easily judged by reading the following detailed description which he gives in endeavoring to prove that the riveted bridge is cheaper to construct:

Eye-bars are often made out of rolled bars with an almost square section; each end is reheated and flattened under a steam hammer to the final thickness, and to sufficient width for the head; the piece is then heated once more and passed through the rolls, where the square body of the bar is simultaneously extended to the required length and flattened to the final thickness. Compared with the rolling of a flat bar this process is expensive, and the reheating of the material, as well as the fact that the bar passing through the rolls is only confined on two sides of its profile instead of four, involves the elements of irregularity of texture and chemical composition, especially if steel is the material. When a variety of lengths and profiles of eye-bars occur in a bridge, trouble arises from the fact that the distance between the heads when made is much smaller than the final distance, and that great experience is required to determine the first profile of the bar. In such cases it is difficult to make a contract at a reasonable price—at least in England. Not long ago this had the curious effect that a number of steel eye-bars, differing in their dimensions from the majority in the same contract, were cut out of flat bars of the width of the head on the planing machine, with the result that money was saved, and that the excellent behavior of the bars under the test could be anticipated.

It is hardly necessary to quote further to show that Mr. AM ENDE was not well prepared to discuss this problem from a practical point of view at least. If he will interview some of the members of the Iron and Steel Institute, who visited Phœnixville and other American bridge works last fall, he may gain a more accurate idea of the methods of making eye-bars adopted on this side of the water. He will then learn the uselessness of comparing the cost of the different systems of construction in English shops, which are fitted for doing riveted work, but are so poorly fitted for making eye-bars that the cheapest method is to cut them out in a planer from a flat bar of the width of the head.

There is unquestionably much to be said in favor of the riveted method of construction, and our bridge practice has certainly been improved by the increased use of girders, and even in some cases of riveted short-span trusses. But the really important points in favor of the riveted structure we do not find in Mr. AM ENDE'S article.

We must heartily commend, however, the writer's summing up:

As in course of time local and other restrictions increase in America, a greater variety of design will probably be—and, in fact, already is—noticeable, and the use of riveted connections in bridges will become more frequent. A complete abandonment of the pin system, however, is not to be expected, because, in the first place, most portable bridges will be constructed according to it, and, in the second place, the pin systems at present in use are capable of being much improved, and the last word has certainly not yet been said about them.

We trust it may be Mr. AM ENDE'S good fortune to visit America and see for himself both the growth in the use of riveted structures for small spans and the improvements which have taken place in the American type of pin-connected bridge since the days of the structures which he supposes to be still models here. He will then probably realize the force of his statement that the last word has certainly not been said about the use of pin connections.

CORRESPONDENCE.

Fireproof Floor Construction.

PHILADELPHIA, PA., July 10, 1891.

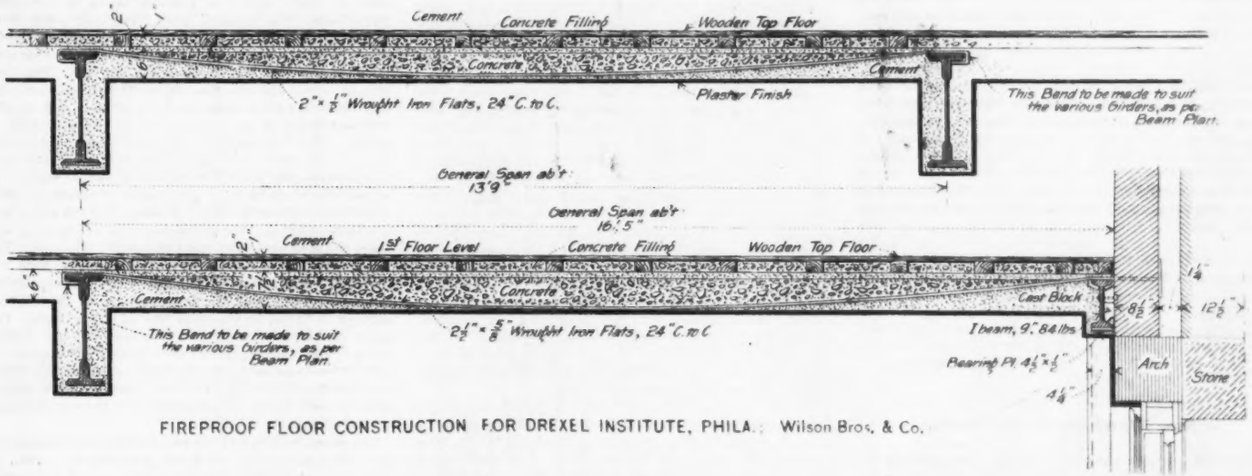
TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of July 4, 1891, you described a new system of fireproof floor construction, as proposed by Mr. F. H. KINDL, Engineer for Carnegie, Phipps & Co., Limited. I should like to call your attention to a system precisely the same, which was devised by the firm of Wilson Brothers & Co., Engineers and Architects, Philadelphia, and published in the *Engineering and Building Record*, May 24, 1890, that is, more than a year ago, and which has already been actually used in construction of floors of the American Philosophical Society and of the Drexel Institute buildings in Philadelphia.

I inclose a blue-print showing the general detail of the floor for the Drexel Institute. The estimated cost of this flooring per square foot as given in the aforesaid article was 35½ cts. details of which may be seen by reference to the article in question.

Yours very truly, JOS. M. WILSON.

[The drawing reproduced above shows the construction referred to by Mr. WILSON. Our readers will notice that the design is practically the same as that noted in the article referred to, and Mr. WILSON is certainly entitled to full credit for priority in publication of his design.—ED. ENG. NEWS.]



FIREPROOF FLOOR CONSTRUCTION FOR DREXEL INSTITUTE, PHILA. Wilson Bros. & Co.

Automatic Freight Car Couplers.

CHICAGO, July 16, 1891.

TO THE EDITOR OF ENGINEERING NEWS.

SIR.—I am somewhat interested in the drawbar business and would be greatly indebted to you if you would kindly answer the following questions:

Who are the members of the Commision to meet in Washington August 5?

Will they simply take testimony from railway employees for or against the M. C. B. type, or will they look into other types?

Supposing they indorse the M. C. B type, will legislation in its favor follow, thus barring all progress?

Please give me such information as you can.

A. C. MARTIN.

[The members of the committee appointed at the Convention of State Railroad Commissions with the Interstate Commerce Commission are Messrs GEO. G. CROCKER, of Massachusetts; JAS. C. HILL, of Virginia; SPENCER SMITH, of Iowa; WM. E. ROGERS, of New York, and JNO. H. KING, of South Dakota. According to the resolutions under which the committee were appointed, they are "to give a hearing to accredited representatives of such organizations of railroad officials or employees as may desire to be heard." We may expect, therefore, that they will listen to whatever testimony the railway men offer. If our correspondent will look into the history of the automatic coupler reform (briefly summarized in our issue of April 25) he can judge how likely the committee are to spend much time investigating the innumerable automatic link-and-pin couplers.

As for the last question of our correspondent, being neither a prophet nor the son of a prophet we cannot say what the next session of Congress will do in this or any other matter. The committee was appointed "to urge upon Congress the imperative need for action by that body calculated to hasten and insure the equipment of freight cars throughout the country with uniform automatic couplers and with train brakes, and the equipment of locomotives with driving-wheel brakes, and present and urge the passage of a bill therefor." What bill they will present and what Congress will do with it, remains yet to be seen. We may say, however, that as several state legislatures are passing resolutions urging Congress to take action in this matter, there is a very strong probability that something will be done.—ED. ENG. NEWS.]

The Break in the Reservoir Embankment at Dallas, Tex.

AUSTIN, Tex., June 25, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of June 13 appears a somewhat interesting description of a break in a reservoir embankment at Dallas, Tex., and in the Dallas *News* have appeared still more detailed reports with local expert opinions. On a trip to Dallas last week I had opportunity to examine the work, in which I naturally feel a great interest. There was nothing but an earth slip, some 3,000 cu. yds. of the outer part of the embankment being deprived of its proper support, slipping down to where some earth ought to have been filled any way.

The reservoirs are located so near Trinity River that they are in absolute danger without artificial protection of the river banks and some of the slopes; yet they have been left unprotected for 9 months after the building of the embankment was practically completed. Proper recommendations were made by Engineer J. D. COOK, but they had not been carried out. We can only regret that a work of such magnitude shall go to destruction for lack of intelligent attention.

N. WERENSKIOLD,
Constructing Engineer.

Some Quick Work.

TROY, N. Y., June 5, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: During a visit to Denver, Colo., last week I saw some work that had been done for the American Water-Works Co. by their superintendent, Mr. W. F. MCCUE. The work consisted of digging a 5½-ft. trench and laying 4 miles of water pipe varying in size from 6 to 16 ins. in diameter. While that work was being done 62 valves and 248 hydrants were set in an old main in another part of the city. As each hydrant was set it was necessary to shut off the water, pump water from the trench, cut a suitable piece out of pipe, put in a T, a sleeve, three joints of pipe, then the hydrant, with its valve as a secondary gate, making an average of 10 joints for each hydrant. When we take into consideration that all this work was done in two weeks I think you will agree with me that it was a notable feat.

JABEZ STONE,
Superintendent Ludlow Valve Works.

Title and Rank.

TOLEDO, O., July 18.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: It seems to me that a halt ought to be called in the vague way in which the terms assistant engineer, division engineer, resident engineer, etc., are employed. In the United States engineer service, where all the credit is taken by the army officers, the civilians, who really do all the work, are "assistant engineers," whatever that may mean, as long as they may stay or whatever their responsibility. A few years ago the engineer of apparently highest rank on the whole great Missouri-Pacific system was a resident engineer, while in some places in Pennsylvania a chief of party, which it seems to me is a good term, was a principal assistant engineer, and the transitman and leveler were designated respectively as the assistant at the transit, and the assistant at the level. In the Sioux dialect we might say The-Man-Who-Carries-the-Theodolite and the Young-Gentleman-Who-Manipulates-the-Heights.

The main thing is to have the terms used in a definite and uniform way, so that they may imply relative ranks as clearly as do the terms colonel and captain in the military service. That they lack such definiteness is a matter for which engineers are in themselves wholly to blame, and in great part because they depart from standards already set up.

Now if an engineer has been in charge of from 30 to 50 miles of railroad construction, has been responsible for the lay-out and manner of execution, has kept an office, left records, made up estimates, and, especially in the service of the larger corporations, has rendered duties such as were recently performed by chief engineers, he is certainly entitled to be distinguished in some way from the four or five others who have been his assistants and subject to his orders.

Mr. SHUNK, who certainly speaks by right, calls the former a Division Engineer, and the lesser position a Resident Engineer, as does Mr. SEARLES, another high authority, and I believe the practice a common one in the East. In the West, however, such companies as the C. B. & Q. and the A. T. & S. F. invert the terms and call the former a Resident Engineer. A frequent misuse of the term is when there is a Chief Engineer for a short line of 20 to 50 miles, and to whom the men immediately engaged in cross-sectioning and looking after 10-mile residencies report directly. The engineer in charge may be very properly styled a Chief Engineer, though he may in the main perform such functions as on a larger system are discharged by Division Engineers; but it does not follow that he should thereby give such assistants a title above their rank.

Let other engineers express themselves so we may find out the general practice, and then let it become uniform.

CHIEF ENGINEER.

New Warships of the World.

According to *Brassey's Annual*, just published, the United States is building and rebuilding 12 armored ships of a total displacement of 72,720 tons. There are three coast-line battle-ships of 10,300 tons each now building, one armored cruiser of 8,150 tons; one turret ship of 6,300 tons, one coast-service turret-ship of 4,000 tons, and one ram of 2,050 tons; or a total of 51,400 tons of new ships. The speed of the new ships ranges from 16 to 20 knots; and the guns range in calibre from 8 in. to 13 in. The armor being used ranges from 5 ins. to 18 ins.

Great Britain is building eight battle-ships of a total displacement of 109,550 tons, seven of which have a displacement of 14,150 tons each. In speed they range from 17.5 to 18 knots; in armament from 10 in. to 13½ in., and in armor from 12 to 18 ins.

France is building 13 ships of an aggregate of 87,961 tons; with one battle-ship of 12,000 tons. The speed ranges from 13 to 19 knots; the guns, from 7.5 to 13.4 ins. in calibre, and the armor from 8 to 17¾ ins.

Italy is building one 13,250-ton battle-ship of 18 knots speed, armed with 13.4-in. guns and armored with 18 ins. of metal. A second similar ship is to be laid down. The count for Germany is 8 warships of an aggregate displacement of 54,000 tons. The speed for all is 16 knots; the armament ranges from 9.5 to 11 in. guns.; the armor ranges from 9.5 to 15¾ ins. in thickness. Russia is building 5 ships of a total of 32,756 tons. The speed limits are 15 and 18 knots; the guns range from 8 to 12 ins. in calibre, and the armor is 5 ins. thick on gunboats to 16 ins. thick on battle-ships. Spain is at work on two 7,000-ton armored cruisers, which are to have the high speed of 20 knots, mount 11-in. guns and carry 10½-in. armor. Chili is having built for it in France a battle-ship of 6,900 tons, with 19-knot speed, 9.3-in. guns and 12-in. armor. Denmark has in hand a 3,290-ton steel turret-ship, with 10-in. guns, 15.5 knots speed and 12 ins. of armor. Sweden is building a turret-ship of almost similar dimensions.

Heating Feed-Water with Live Steam.

We reprint the following article from *The Engineer* of July 3, and have commented upon it in our editorial columns:

Two or three years ago Mr. JOHN KIRKALDY, of West India Dock road, invented an apparatus for heating feed-water with what Americans have not inaptly called "live" steam—that is to say, steam which, drawn fresh from a boiler, has done no work. It is well known that when the fires are lighted in a marine boiler, and for some hours afterward, the bottom water remains cold. The boiler is thereby exposed to very severe strains, which it is most desirable to avoid. Mr. KIRKALDY'S first idea was to heat up the water with steam from the donkey boiler. The result obtained was satisfactory. The primitive idea underwent a process of development, and finally a heater was devised through which all the feed-water was pumped and raised to a high temperature by steam drawn from the boiler. There was no intention of saving fuel. The sole object had in view was to do away with the mischief that every marine engineer knows is caused by pumping cold water into the boilers of a ship. With hot feed-water, leaky tube ends and riveted seams no longer vex the soul of the engineer.

It was found that the Kirkaldy heater answered its purpose perfectly, but an entirely unexpected result, also followed on the use of the heater. Coal bills were reduced and boilers which were before short of steam now made it in abundance. Such was the statement made to us and we received it with incredulity. But report after report, log after log, all told the same story, and the fact that shipping firms beginning with one heater on trial, went on and ordered others, was a fact not to be gainsaid. On the face of affairs the process of heating feed-water with live steam looks like taking money out of one pocket and putting it into another, and it is very far from easy to see how any economy in fuel can result. It is certain, however, that finality has not been reached in the thermo-dynamics of the steam engine; and it was as difficult to dispute the testimony of those who paid for coals and said the live steam heater reduced the consumption, as it was to doubt the accuracy of the view that theoretically no economy was possible. Under the circumstances nothing remained but to put the question to a practical test for ourselves. For some time no opportunity occurred. On Tuesday, however, thanks to the courtesy of Mr. PRESTON, the Superintendent Engineer of the General Steam Navigation Co., we were enabled to carry out experiments with a heater in a way and with results which we shall now proceed to explain.

The *Oriole* is one of the little fleet of paddle-wheel passenger steamers plying during the summer months between London, Margate, Ramsgate, Deal and Dover. She was built and engined by Messrs. Scott, of Kirkaldy, and is a very fast and beautifully-fitted vessel, commanded by Captain FISHINGDON. She is 386 tons register. She is propelled by compound engines, the cylinders lying side by side and inclined at an angle of some 30° with the keel. The cylinders are placed abaft the right-angled crank shaft. The air, feed and bilge pumps are worked by a bell-crank lever from the low-pressure crosshead on the star board side of the engine-room. On the port side is a double cylinder centrifugal pump for driving water through the surface condenser. The engines indicate about 1,500 HP. Steam is supplied by three boilers, of the low or Navy type. They are about 9 ft. in diameter and about 13 ft. long. There are in each three plain cylindrical furnaces opening into one combustion chamber, from which extend tubes about 6 ft. long and about 2½ in. in diameter to a smoke-box. There is a single elliptical funnel serving for all three boilers, which stand side by side fore and aft in the ship, forward of the crank shaft. The stokehold extends right across the ship, and is separated from the engine-room by a transverse bulkhead, in which are two doors to port and starboard. There are two firemen on watch, who have to feed nine furnaces; one takes the starboard, the other the port boiler, and they fire the central boiler alternately. Two furnaces are always fired at the same time. The coal used on Tuesday was North-country, of average quality, but with a good deal of small in it and not very clean.

In the aft corner of the stokehold, on the starboard side, stands the heater. It is a plain cylindrical vessel, in which are copper tubes. The feed-water is always passed through this, entering at the bottom and escaping at the top to the boilers. The steam enters at the top through a pipe 1¼ in. in diameter, drawing steam from the mid-ship boiler. The condensed water is led through a small copper pipe into the hot well. The heater occupies a space 6 ft. 10½ in. high by 18 in. by 21 in., and weighs about 21 cwt. By turning a tap on the steam pipe, steam can be admitted to the heater or not at pleasure. There are, of course, by-pass valves, so that if the heater failed the boilers could still be fed in the ordinary way. The safety valves are loaded to 100 lbs.

It was impossible to make any experiments on Tuesday to ascertain the evaporative efficiency of the boilers. The only trials that could be made were, however, of much practical importance. Before the heater was put in the engines were always short of steam. A fan is provided on the crank platform in the engine-room, which delivers air into the stokehold, to work on the assisted draft principle. For some reason, however, not stated, this fan is not used, and it had been found impossible to keep the pressure up to 100 lbs. In some cases, indeed, when the coal ran dirty or small, 85 lbs. could be maintained with difficulty. Since the heater was put in there has been no trouble of this kind. Mr. HARPER, the able Chief Engineer, gave us on Tuesday during a trip from London Bridge to Dover, every facility for carrying out any experiments we pleased. These consisted in working the boilers alternately with and without steam in the heater. Matters were so managed that the firemen did not know whether the heater was in action or not. Indeed, seeing that, as we have said, two men had to manage nine fires they had, it may be easily understood, no time to think about heaters. Mr. HARPER, like many other engineers, holds that it is on the whole more economical to be satisfied with about 22 ins. of vacuum, than to cool his feed-water below 140°, at which temperature it enters the heater. We used a standard mercury thermometer placed in a thin pipe on the top of the heater, just at the point where the feed-water left it. The temperature ranged between 318° and 320°, corresponding to pressures of 88 lbs to 90 lbs.

No experiments were made until after the *Oriole* had left Blackwall, and could steam full speed without much chance of having to slow up or stop. With the steam off the heater and the feed temperature 140°, the pressure was 92 lbs., and the engines made 34 revolutions per minute. The firemen were fresh and certainly did not spare themselves. And here we may say that all four—two being on watch at a time—were considerably above the average both in physique and skill. The pressure, however, did not rise above 92 lbs. and was kept there indeed with some difficulty. At the end of about three-quarters of an hour steam was turned into the heater. The temperature of the feed began to rise, and in about a quarter of an hour attained 320°. The boiler pressure steadily rose to 97 lbs. and remained there. Obviously the work of firing was easier. The men could put down their shovels for a few minutes and the rakes were not in requisition. We prolonged this experiment until there could be no doubt about the facts. The revolutions rose to 35½, an increase of a revolution and a half. We then had steam turned off the heater, with the result that the pressure began to fall, went back to 90 lbs and was only got to 93 lbs. by vigorous use of firing tools. Once again we had the heater put into use and the pressure was got up for some time to very nearly 100 lbs, and the revolutions rose to 36. Again, later in the day, the heater was thrown out of use, and the prickers were soon at work to push steam. The remainder of the trip was made with the heater in use.

The broad facts which we ascertained were simply that the heater gave a higher boiler pressure by 5 lbs., and raised the revolutions of the engines from 34 per minute to 35½ per minute. As regards economy, we have no data to go on, save that the firemen let the furnaces more alone with the heater than without. It may be taken as certain that an extra revolution and a half was got out of the engines with less coal per hour when the heater was in action than when it was at rest, but how much less we cannot pretend to say.

It remains to be considered how this remarkable result can be reconciled with thermo-dynamic laws. At first sight it appears to be, as we have said, impossible that any result of the kind could be got, or that any economy should result. But we think that an hypothesis may be constructed which will show that there is really nothing at all inconsistent with thermo-dynamic laws about the matter. If we take into account the well-known fact that heating surface is, for some reason not fully understood, more efficient with boiling water than with cold; that all grease is kept out of the boiler, being deposited in the heater, from which it is periodically removed with soda, and that so the surfaces are kept cleaner, we can at once see that a saving of 5% or 6% is not more than is to be expected. Putting the whole matter in another way, it is clear that the efficiency of a boiler working with hot feed will be greater than the efficiency of a boiler working with cold feed.

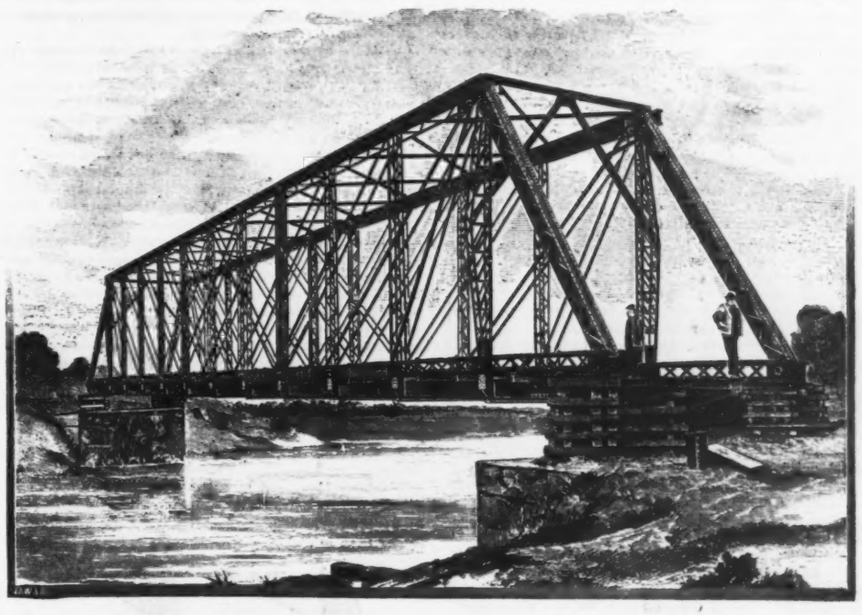
The Kirkaldy heater is supplied with steam from a boiler working with feed-water at a very high temperature indeed, and the efficiency of each pound of fuel employed to heat that feed will be greater than it would be if the steam were supplied by a boiler working with cold feed. From this point of view it will be seen that a moderate gain is just what may be expected under thermo-dynamic laws. The fact that there is a greater gain than calculation indicates as possible is explained, as we have said, by the more or less uncertainty which exists as to the influence of the density of the water in a boiler on the rate at which it will take up heat. Each unit, again, of heating surface will probably in a given time transmit

about the same quantity of heat, whether the water in contact with it is 200° or 350°, or even hotter, because the furnace temperature is always so much in excess of the water temperature that 100° or 150° one way or the other makes little difference; but it is obvious that, if the water be very hot, more steam will be produced in a given time per unit of surface than if it be cold. The result is equivalent to an augmentation of furnace-heating surface, and, as in the case of the *Oriole*, more steam will be made per hour than could be had from the same boilers with cold water. The steam used in heating the feed is used to the best possible advantage, the whole of its contained heat being utilized; whereas if the same steam were passed through the engine, not more than 12% of its heat could be utilized.

Our readers must not run away with the idea that when a live-steam heater is used something is being got for nothing. That is not the case. There must under any circumstances be work done by the fuel in raising the temperature of the feed-water. Can that work be done more economically by using live steam than by pumping lukewarm water into the boilers, and using the live steam in the engine? The reply supplied by practice is that it can, and the theory we have advanced seems to explain why this should be so. It simply means, among other things, that a given weight of steam can be utilized to more advantage in heating feed-water than in turning a crank shaft; and that a given weight of fuel can be used to more advantage in making steam than in heating water.

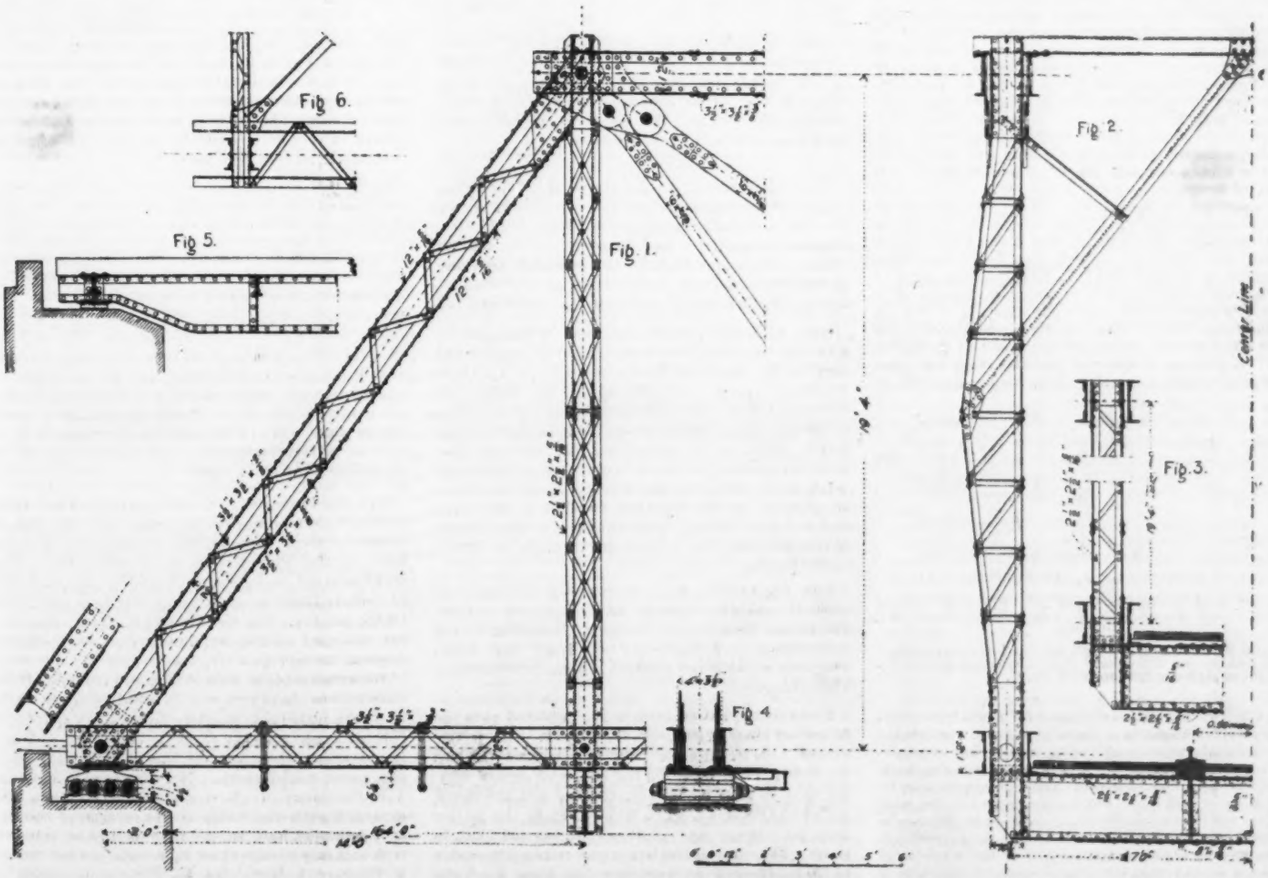
A Brazilian-British-American Bridge.

A great deal has been said and written upon the relative merits of the English and American types of truss bridge; and the latter has met with frequent and various criticisms at the hands of English engineers. In a recent number of a new British technical journal, *The Engineering Review*, we find an article by Mr. MAX AM ENDE, M. Inst. C. E., in which that gentleman describes a bridge designed by him for a Brazilian railway in which he attempted to follow and improve upon American practice in bridge construction. We reprint the article in full as follows, and have commented upon it in our editorial columns. We shall have to apologize to our readers for the illustrations; but we could only reproduce them as published by our contemporary, adding such dimensions as were legible.



BRIDGE FOR THE ALAGOAS RAILWAY IN BRAZIL.
Max Am Ende, M. Inst. C. E., Engineer. Andrew Handyside & Co., Builders.

The bridge illustrated carries a metre-gauge railway, and was designed according to the specification of the Engineer to the Alagoas Railway Company, Mr. D. MAKINSON FOX. The perspective view is made from a photograph taken on the site. Fig. 1 shows an elevation; Fig. 2, cross-section at the vertical portal; Fig. 3, cross-section at an ordinary vertical; Fig. 4, cross-section at the bearing; Fig. 5, detail of rail-bearer at the end of the bridge; Fig. 6, plan of termination of top bracing; Figs. 7 and 8 are outline diagrams with the strains and sectional areas. The clear span is 164 ft., and the length between bearings, 168 ft., is divided into 12 panels of 14 ft. in length. The depth between centers of flanges is 19 ft. 4 ins. The main girders are constructed with pin connections; but, instead of having a bottom flange composed of eye-bars, as is the case in the majority of bridges of this class, the present bridge has one similar to the top flange, which is composed of angle bars and plates. The



DETAILS OF BRIDGE FOR THE ALAGOAS RY.

inclined end struts, as well as the diagonals and verticals, are connected with the flanges by pins. The cross girders are riveted to the verticals as usual, and the upper and lower wind bracings are connected by rivets. The principal reason for adopting the pin system was the greater facility with which pin bridges can be erected in distant parts compared with riveted bridges.

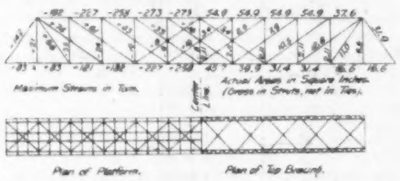
The moving load is assumed at 1 ton per lineal foot, and the weight on the heaviest axle at 10 tons. All parts being of mild steel of 30 tons breaking strength, the strain per square inch does not exceed 6 tons tension on the net area, or 5 tons compression on the gross area.

The construction of bridges with pins and eye-bars has attained a high degree of perfection in America, and the practice is there at present almost universal, whereas in Europe riveted bridges have generally been preferred. The manufacture of eye-bars was most developed in England at the time when suspension bridges were in fashion, but since then it has gradually declined.

In those cases where, nevertheless, pin bridges are made in England, the American specifications, as well as the details, are generally considered authoritative, and in the present case the outline of the main girders is also according to American pattern; some modifications of the usual practice have, however, been introduced besides the construction of the bottom flange already mentioned. The modifications may be summed up as follows:

1. It is usual to make the junction of the inclined strut with the top flange by means of a butt joint, instead of an overlap joint, on the pin, in order to make room for the vertical and diagonals. Each member then contains a half pin-hole, and the pressure is not in the middle of this half. In order to guard the two members against slipping off the pin, a riveted connection is often added, but the movability of the pin connection is thereby abandoned. In the present structure both members have complete pin-holes, the movability of the connection is retained, and greater accuracy in the work during manufacture and erection is assured. The two main diagonals are fixed on separate pins.

2. The overhead wind-bracing usually terminates in the *inclined portals*, *i. e.*, braced frames between the inclined struts. They have generally the form of a horseshoe, the two branches of which terminate at the pin at the lower end of the inclined strut. Between the pin and the fixed line on the abutment a space necessarily occurs, through which not only the vertical pressure, but also all horizontal forces and vibrations are transmitted. Instead of effecting this by the usual blade-like structures, it would be desirable to insert a single solid or braced structure, but this is impossible without abandoning here also the movability of the pin connection. In the present structure the difficulty is avoided by placing the portals between the first vertical. The upper wind-bracing is thus carried into the lower wind-bracing, and through it direct to the fixed line on the abutment, as seen in Fig. 4. The blade-like structures mentioned above are relieved from lateral strains, and the pin connection retains its movability. Further, the portal or horseshoe frame can now be continued under the platform by means of the cross girder and be made a complete frame. Other advantages are that the design, manufacture and erection of these parts are simplified. It should, however, be noticed that the two pins, which are met by the bracing as it descends through the vertical portal to the lower bracing, have ceased to be proper pin connections for the vertical. Here, as in the case of the inclined portal, the choice lies between perfect pin connections with an incomplete bracing and a complete bracing with partial abandonment of the pin connections. But the pin connections, abandoned in the case of the vertical portal, are comparatively unimportant. In point of economy of material, there are small differences between the two arrangements according to



Figs. 7. and 8. Strain Sheet and Plans of Lateral Bracing.

Total fixed load 0.494 tons per lin. ft.; total moving load 1,000 tons per lin. ft.; weight of steel 0.400 tons per lin. ft.; weight of platform 0.094 tons per lin. ft.

the different distribution of strains from wind pressure. A general investigation of them is difficult, because the two horizontal systems of bracing are not free to turn at the supports independently of each other, and are, therefore, statically undetermined. Assuming them to be independent of each other, the bottom flanges of the main girders will have a greater strain from wind pressure in the case of vertical portals; but, as the force producing this difference is only a small portion of the whole wind pressure on the bridge, this disadvantage is generally of no importance. The practical advantages are, as already stated, with the vertical portals.

3. If the bottom flange of the main girder is composed of eye-bars, the proper points of attachment of the lower, *i. e.*, the principal wind-bracing, would be the pins; but thoroughly satisfactory connections with stiff or with flexible diagonals are difficult to make, and the latter, moreover, require a stiff transverse member between opposite pins. The cross girders are hardly ever seen exactly in this position; if they are, as usual too high or too low, and if the flexible diagonals are fixed to the cross girder at its attachment to the vertical, then this important bracing, considered as a horizontal girder, has no flange in its own plane. A perfect bracing is, however, often obtained by introduction of a platform stringer alongside the bottom flange of the main girder, and by fixing the diagonals of the wind bracing to it. In the present structure the stringer and the bottom flange are made the same thing, and the diagonals are fixed to the point of intersection between flange and vertical, thus also making a perfect bracing. The diagonals are made to act in compression as well as in tension, and they are not fixed with an initial strain, as is usual in the case of flexible diagonals.

Road Roller.

The accompanying cut represents a road roller of 5 to 7 tons weight. The roller is of large diameter made in narrow sections, which, with the application of the fifth wheel for short turning, makes easy to

Road Roller.

handle in working. Corrugated instead of plain rollers can be used if desired. The front wheels are of iron, broad-faced, and give additional rolling surface. A tray is furnished back and front for increasing the weight. The machine is manufactured by Thomas Carlin's Sons, Allegheny, Pa.

A CONTEST OVER "SMOKE CONSUMERS" is engaging the attention of the Omaha City Council. It was voted at a recent meeting to purchase four smoke consumers, made by one HERBERT, of St. Joseph, Mo., for the sum of $3,300. As an Omaha paper puts it, they consume cash if not smoke; and the consummation of the purchase is being vigorously opposed.

THE REORGANIZATION OF THE WESTINGHOUSE ELECTRIC CO. has been satisfactorily carried out, and such financial heavy weights as CHARLES FRANCIS ADAMS, AUGUST BELMONT, HENRY B. HYDE and BRAYTON IVES are among the members of the new Board of Directors. With abundant capital to carry on its operations, the company may now be expected to take hold of electrical industries with new vigor. It has worked some important revolutions in the electrical business in the past, and it is not unlikely that changes of even greater importance may be introduced through its efforts in the future.

THE COVINGTON, KY., SUSPENSION BRIDGE is to have its cables inspected at an expense of from $15,000 to $20,000. Mr. GEORGE BOUSCAREN, the well-known civil engineer, will direct this work. The chief trouble and expense will lie in examining the anchorages.

THE BRAZOS RIVER JETTIES are reported as in the following stage of progress for July 14: The jetties extend 5,400 ft. into the Gulf and beyond the bar. There is 16 ft. of water on the bar, with depths varying from 25 to 35 ft. between the bar and the shore, where the river is 1,000 ft. wide. Before the jetties were built there was 4½ ft. on the bar and 10 ft. in shore. The crest of the bar is now reduced in width to 100 ft., though no dredging has been done; the littoral currents alone have cleaned out the channel defined by the jetties. About $1,500,000 is said to have been expended on this work in the last two years.

THE STANDARD ASPHALT CO., of Kern Co., California, is reported to be turning out from 15 to 20 tons of refined asphaltum daily. It is said to be capable of refinement to 90%, as compared with 68% for the Trinidad article. In this same county "a crystallized asphaltum" is being mined and shipped in its natural state. It is said to be worth $50 per ton and is used as a basis for the fine varnish employed in car work, etc.

A COMPANY DEALING IN WIND is said to have been organized in Kansas City for the purpose of delivering through a system of pipes cold air in summer and hot air in winter, for ventilating and heating business and private houses. The process is the invention of Mr. DANIEL O'KEEFE. He claims that the temperature can be regulated from 70° F. to zero. The estimated cost of the plant is $250,000 for Kansas City. A franchise has been granted by the Common Councils, providing that 2,000 ft. of conduit shall be in use within 2 years and the work commenced in 6 months.

FOR THE NEW CABLE MACHINERY of the BROOKLYN BRIDGE there are three bidders—the Southwark Foundry & Machine Co., $15,950 for the new engine; Wm. Wright & Co., $11,195, and Robert Pool Sons & Co., price not named. The bids for the driving plant, etc., are made in pounds, and must be figured out by the chief engineer, to whom these bids are referred.

CALIFORNIA IRON ORES are to be utilized. The ore to be used is situated in San Bernardino Co., about 150 miles east of Los Angeles and 12 miles from the Atlantic & Pacific R. R. It is of the magnetic variety, and lies in a well-defined contact vein from 400 ft. to 600 ft. in width and 3,000 ft. long, and apparently of great depth. The ore is quite accessible, and can be mined at very little expense, and, as the following analysis shows, is very pure:

Metallic iron	68.84
Manganese	0.038
Phosphorus	trace
Sulphur	1.078
Titanium	0.20

The silica runs below 2%. The cost of producing pig iron from this ore, calculated on a basis of 50% of metallic ore, is estimated to be $13.75 per ton. The present price of pig iron in California varies according to quality from $26 to $35 per ton. The plant to be established will be of 100 tons daily capacity, and will be operated by the direct process of manufacturing iron and steel which was described in ENGINEERING NEWS March 24 and April 14, 1888. It is stated that work will begin on the plant at once, and, as it is very simple, it is expected to be in operation at an early date.

THE STANDARD METAL TIE described in our issue of Feb. 7, 1891, is now being laid, in an experimental section of about three-fourths of a mile, on the main line of the Philadelphia & Reading Ry. The point selected is between Columbia Ave. and 16th St., where there is an average traffic of about 200 trains per day. The ties are laid in cinder-slag ballast and used with an 80-lb. rail. The road officials express themselves well pleased with the behavior of the small section now in use, and it undoubtedly shows a vast improvement in solidity under traffic over the adjoining wooden ties. The experiment is being made with the expressed intention of largely extending their use on this road, if these first ties prove satisfactory. Mr. BENJAMIN NORTON, Vice-President of the Long Island Ry., has also arranged with the company for a trial of this tie. It is pertinent here to say that the ties of this pattern laid down nearly two years ago on the Chicago & Western Indiana Ry. have been subjected to

ELEMENTS OF WEATHER IN THE UNITED STATES, OF MOST INTEREST TO ENGINEERS, FOR THE MONTH OF JUNE, 1891.
[Furnished to ENGINEERING NEWS by the Department of Agriculture.]

	STATION.	Temperature. (Deg. Fah.)				Wind.			Precipitation—Rain and melted snow. Inches.		
						Velocity in miles per hour.					
		Average.	Max.	Min.	Range.	Average.	Maxim.	Direction at time of max. velocity.	Total.	Heaviest in 24 hours.	Number of rainy days.
NORTHERN CITIES.	Northfield, Vt.	61.4	91	30	61	8.2	36	NE	2.04	0.86	13
	Portland, Me.	61.3	95	42	53	7.1	24	NE	2.77	1.24	11
	New York City	69.6	94	51	43	9.1	35	NW	1.18	0.39	11
	Pittsburg, Pa.	72.3	92	50	42	4.7	16	S	3.90	1.08	10
	Chicago, Ill.	65.7	88	44	44	13.9	45	E	2.42	0.79	11
	Omaha, Neb.	69.4	92	46	46	8.2	26	S	6.06	2.32	15
	St. Paul, Minn.	65.5	89	40	49	7.7	36	NW	4.08	1.36	13
	Duluth, Minn.	53.8	85	35	50	6.6	30	NE	2.67	1.09	13
	Bismarck, N. Dak.	60.4	87	40	47	13.3	54	NE	4.19	1.47	14
	Average	64.4	90.3	42.0	48.3	8.8	33.6	.....	3.32	1.18	12
SOUTHERN CITIES.	Washington City	72.0	94	45	49	5.0	27	N	4.61	1.63	11
	Louisville, Ky.	77.7	95	59	36	5.6	34	SW	2.00	0.47	15
	St. Louis, Mo.	75.7	93	54	39	9.2	39	W	5.97	1.69	15
	Savannah, Ga.	80.0	97	68	29	6.9	26	NW	1.98	1.09	11
	Leavenworth, Kan.	...	...	...	...	...	...	...	...	...	...
	Jacksonville, Fla.	81.1	100	68	32	7.3	35	W	3.31	1.05	12
	Chattanooga, Tenn.	78.6	96	60	36	4.3	32	NW	7.58	2.94	18
	New Orleans, La.	80.8	94	66	28	7.0	30	N	4.45	2.08	14
	Memphis, Tenn.	79.5	97	62	35	5.8	42	NW	4.74	1.31	13
	Palestine, Tex.	79.9	93	60	36	5.9	24	E	2.27	1.18	5
	Average	78.4	95.8	60.2	35 6	6.3	34.3	.....	4 10	1.49	13
WESTERN CITIES	Helena, Mont.	...	...	...	...	...	...	...	...	...	...
	Port Angeles, Wash.	53.2	70	36	34	3.6	14	N	0.83	0.19	14
	San Francisco, Cal.	60.2	100	48	52	11.0	32	SW	0.11	0.10	2
	Salt Lake City, Utah.	62 0	84	41	43	5.7	30	N	1.08	0.83	5
	Denver, Col.	63.4	91	43	48	7.4	30	NW	2.98	1.32	11
	Yuma, Ariz.	81.8	116	52	64	6.6	34	W	0.00	0.00	0
	Santa Fé, N. Mex.	62.6	84	38	46	8.3	31	NE	1.26	0.36	5
	Average	63.9	90 8	43.0	47.8	7.1	29 5	.....	1.04	0.47	6

a traffic of over 60,000 trains, and they are still in perfect condition. We understand, on personal inquiry made, that during this time they have cost nothing to keep them in repair, line or surface.

THE NEW YORK RAPID TRANSIT COMMISSION has decided on a route for a rapid-transit line on the east side of New York City. The resolutions adopted at the meeting on July 22 were as follows:

Resolved, That this board approves a plan for an underground four-track railway diverging from the proposed Broadway line at or near Fourteenth St., and running thence under Union Square and Fourth and Park Avenues, to near and south of Forty-second St.; thence by a suitable curve to the westward under such private property and streets as shall be found practicable to Madison Ave. at or near Forty-fourth St.; thence under Madison Ave. to a point at or near Ninety-sixth St.; thence curving to the eastward to a point not less than 100 ft. east of Madison Ave.; thence by a viaduct over private property parallel to and not less than 100 ft. east of Madison Ave. to a point near and south of One Hundred and Thirty-fourth St.; thence by a curve to the eastward and by a bridge across the Harlem River.

Resolved, That the general plan of construction from Broadway to a point near Ninety-sixth St. shall be either by a double-decked tunnel with two tracks on each deck or four tracks upon the same level, as may be found upon further examination and survey to be most expedient, and as near the surface as shall be found practicable; from near Ninety-sixth St. north to be by viaduct with four tracks to the Harlem River.

Resolved, That the conditions as to location of stations in tunnel and all appliances connected therewith shall be substantially the same as those required for the proposed west side line described in resolutions of this board approved May 27, 1891. [See ENG. NEWS, June 6.]

Resolved, That the engineers of this board are hereby directed to make the necessary surveys, plans and specifications for the above described east side line south of the Harlem River at the earliest practicable date and submit the same promptly to this board in such form and manner as may be necessary to place the same before the Common Council of the City of New York, as required by the Rapid Transit Act of Jan. 31, 1891.

Resolved, That from the Harlem River north to the city limits the exact location and mode o construction can be determined only by instrumental survey, having due regard to the present sparseness of population and necessary economy of construction, and that the engineers of this board are hereby instructed to make such surveys at the earliest practicable date, but without delaying the preparation of the plans and specifications for that portion of the line south of the Harlem River.

Plans for the construction of the west side line have been prepared by the engineering staff of the Commission, Messrs. WM. E. WORTHEN and W. B. PARSONS. A decision on them is expected to be reached soon.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Bristol.—Work has been resumed on this railway from Fairhaven to Bristol, Vt., 7 miles. President, Josh. I. Ridley, Bristol.

Beech Creek.—It is stated that this company will soon let contracts for building the 16-mile extension from near Gazzam to Lajose, Pa.

Lehigh Valley.—A press dispatch from Tremont, Pa. says:

Engineers of the Lehigh Valley R. R. Co. are in this vicinity making surveys for a new road. For some time past the managers of the Lehigh Valley and Philadelphia & Reading railroad companies have been trying to arrange a deal whereby the former could gain an entrance into Baltimore. Preparations are being made to broad-gauge the Baltimore & Lehigh R. R. between York, Pa., and Baltimore, and a branch road is to be built to Bel Air, Md., which will be a considerable distance shorter than the old route. Work on the new road is to be commenced about the middle of August. The Lehigh Valley will extend its lines from a point near this place through Lebanon, Lancaster and York counties.

Pennsylvania.—This company, it is stated, will soon begin the construction of a line from the southern end of Newark, N. J., through the hill district to a point near the intersection of Parrow and Center Sts. with the intention of extending the branch to Orange, Montclair and Paterson, N. J., ultimately.—Surveys are yet in progress for the extension of the Chestnut Hill branch to the Trenton Cut-off. A considerable grade will have to be overcome between the two points.

Dutchess County.—This road has been taken out of the receiver's hands, and it is stated that construction will be resumed at once. It is hoped to have the line finished by Nov 1. Arthur B. Paine, Poughkeepsie, N. Y., is Chief Engineer.

New York Central & Hudson River.—This company has announced its readiness to begin work upon its proposed terminal improvements at Buffalo, N. Y. The work includes the elimination of all grade crossings and the construction of a new passenger station, and is estimated to cost about $3,000,000.

Lehigh Valley.—Tracklaying has been begun on the Buffalo & Geneva R. R. at Phelps Junction. A large quantity of track material is on hand and work is to be pushed.

Adirondack & St. Lawrence.—Work from Poland, N. Y., north is making satisfactory progress. The bridge across West Canada Creek, at Poland, is nearing completion, and from this point north to Gravesville, N. Y., four miles, the roadbed is nearly ready for the track. Between Gravesville and Trenton Falls there is considerable heavy work and slower progress is being made. At Trenton Falls a 260-ft. cantilever bridge will be built across West Canada Creek. From Trenton Falls to Remsen grading has been begun and is being rapidly pushed. A large quantity of ties are on the ground and tracklaying is to begin at Poland this week. At the northern end the grading is well advanced between Valleyfield, P. Q., and Malone, 30 miles, and tracklaying will soon begin. South from Paul Smiths construction is making good progress. The branch from Tupper Lake junction toward Saranac Lake is graded and tracklaying is now in progress.

Cornwallis Valley.—This company has applied to the Canadian Government for a subsidy to aid in the construction of the proposed extension from Centerville to Middleton, N. S., 26 miles.

Toledo, Walhonding Valley & Ohio.—Bids are asked for the grading, bridging and masonry on 46 miles of this road between Coshocton and Loudonville, Ohio. For full particulars see our advertising columns.

Projects and Surveys.

Toledo & Chicago Bee Line.—A special dispatch from Goshen, Ind., says:

There is hardly a doubt now that the Toledo & Chicago Bee Line, the new short line from Toledo to Chicago, will be completed before snow flies. The right of way from Toledo to Goshen is purchased, and the contracts for building the road the greater part of this distance have already been let. The projectors are the people of the Brice-Thomas syndicate. The road will furnish a short entrance to Chicago for the Wabash, the New York, Lake Erie & Western, the Louisville, New Albany & Chicago, and the Canadian Pacific. The Wabash people will furnish the greater part of the money necessary to complete the line to La Porte, Ind., and from there the New York, Lake Erie & Western will furnish means for construction of the line to Chicago. The shops of the road will probably be situated here, this being the half-way point, and the citizens having offered land and over $50,000 cash for them.

Roxborough.—Chartered in Pennsylvania to build a railway from the intersection of Chelton and Pulaski avenues in Philadelphia to Plymouth, Montgomery Co. President, Wm. Dixon, Philadelphia.

Canada.—The Railway Committee in the Canadian Parliament has reported favorably the following bills: To incorporate the Collingwood & Bay of Quinte Ry. Co., the Buffalo Lake & Battleford Coal & Iron Ry Co., the Atic-okan Iron Range Ry. Co., the Victoria, Saanich & New Westminister Ry. Co., the Kingston & Pontiac Ry. Co., the Brighton, Warkworth & Norwood Ry. Co., the Toronto, Hamilton & Buffalo Ry. Co., the British Columbia Southern Ry. Co., and the Peterborough, Sudbury & Sault Ste. Marie Ry. Co.

Cheboygan & East Michigan.—Chartered in Michigan to build a railway from Rainy Lake to Butus, Mich. Among the incorporators are: Geo. F. Reynolds, Cheboygan, and Merritt Chandler, Anway.

New York, Philadelphia & Chicago.—Chief Engineer Geo. C. Hamilton, of Franklin, Pa., has, it is stated, begun the location of this railway from Franklin, Pa., via Clarion, Brookville, Fall Creek, DuBois and Curwensville, to Clearfield, Pa., 90 miles. The preliminary surveys were completed some time ago.

Maine Shore Line.—J. N. Greene, of Bangor, Me., Chief Engineer, writes as follows:

Engineers will soon be put into the field to survey the route for this railway. The road is projected to run from Hancock, Me., via Sullivan, Gouldsborough, Steuben, Millsbridge, Harrington, Columbia, Whitneyville, Machias, Dennysville and Perry, to Eastport, with a branch via Robbinston and Red Bank, to Calais, Me., a total distance of about 112 miles. Portions of the line were surveyed some time ago. The maximum curve will be 8° and the maximum grade 1½%. Between 8 and 12 miles of the right of way have been secured and $850,000 of bonds have been obtained from Washington County.

Press dispatches state that the contract for building the road has been let to L. D. Greene and R. B. Greene, and that work will begin at once at both Hancock and Eastport.

SOUTHERN.—Existing Roads.

South Bound.—The first passenger train was run over this road from Savannah, Ga., to the Savannah River on July 14. The bridge across the Savannah River is completed with the exception of the trestle work and the north side. It is expected to have this completed and the road in operation to Graham, S. C., within 6 weeks. The entire line from Savannah, Ga., to Columbia, S. C., with the exception of 10 miles, is graded, and tracklaying is being pushed.

Macon & Atlantic.—The receiver of this Georgia road has been discharged, and contracts for building the line have been let to McKee & Strange, formerly of the firm of McTighe & Co. It is stated that the funds necessary to finish the road have been secured, and that it will be rapidly pushed to completion.

Middlesborough Belt.—Tracklaying has been completed on the Stony Fork and Cabbin Fork branches. The total length of the extensions is about five miles.

Pineastle & Cloverdale.—The Roanoke Construction Co. is now pushing work at both ends of this Virginia railway.

Chesapeake & Ohio.—The Craig Mineral R. R., running from Eagle Rock to New Castle, Va., was completed July 10.

West Virginia, Central & Pittsburg.—The grading on the line from Elkins to Beverly, W. Va., 7 miles, is practically completed.—The survey for the line to Williamsport, Md., has been completed from Cumberland to Indian Springs.

Chesapeake & Ohio Southwestern.—The citizens of Hopkinsville, Ky., are endeavoring to secure the construction of an extension of the Ohio Valley R. R. from Princeton to Hopkinsville.

Projects and Surveys.

Gulf & Chicago.—A report is in circulation that this enterprise is to be revived.

Georgia.—Bills have been introduced into the Georgia State Legislature chartering the South Atlantic R. R. Co. and the Alcovy & Northern R. R. Co.

Georgia, Virginia & Baltimore.—A bill has been introduced into the Georgia State Legislature to charter this company to build a railway from Atlanta to Baltimore, Md.

NORTHWEST.—Existing Roads.

Pacific Short Line.—It is stated that after the foreclosure sale of this road takes place arrangements will be made to extend it from O'Neill to Dunning, Neb., 90 miles.

Calgary & Edmonton.—Tracklaying has reached a point 15 miles south of Edmonton, N. W. T., and will soon be completed to that place. The graders are being transferred to the line from Calgary south to MacLeod.

Illinois Central.—This company will expend $3,000,000 in improving its roadbed and track between Cairo, Ill., and Dubuque, Ia. The work will include the laying of 90-lb. steel rails.

Winona & Southwestern.—Tracklaying is progressing at the rate of 1 mile per day on this line and it will be completed to Osage, Ia., about Aug. 1.

Projects and Surveys.

Pueblo & Duluth.—The various towns along the route are voting bonds in aid of this enterprise.

Blue Island.—Chartered in Illinois to build a railway from Blue Island to Calumet, Ill. Among the incorporators are: Josiah B. Crocker and E. M. Warren, of Chicago.

SOUTHWEST.—Existing Roads.

Kansas City, Watkins & Gulf.—A very favorable route is stated to have been secured for the proposed extension to Marble City, La., north of Alexandria.

Fort Scott Central.—The Fort Scott & Southern, the Fort Scott & Eastern and the Fort Scott Belt Terminal railroads have been consolidated under the name of the Fort Scott Central Ry. Co., with the following Board of Directors: George J. Gould, S. H. H. Clark, George C. Smith, E. G. Merriam, Russell Harding, J. H. Richards and W. A. Johnson. The headquarters will be at Fort Scott, Kan.

San Antonio & Aransas Pass.—It is stated that the necessary capital has been secured for building the San Antonio & Tampico R. R. from Alice, Neuces Co., Tex., south to Monterey, Mex., a distance of 230 miles. The surveys are nearly completed and it is expected to begin construction in September.

Projects and Surveys.

Kansas City, Springdale & Clarksville.—Chartered in Arkansas to build a railway from Springdale to Clarksville, Johnson Co., Ark. The directors are: John Smart, C. W. Schneider, H. L. Cross and S. H. McGill, all of Bentonville.

Omaha, Kansas Central & Galveston.—A correspondent writes us that the contract for building this road from Superior, Neb., to the Gulf of Mexico, a distance of about 800 miles, has been let. This is a pretty large contract for a year when railway construction is as dull as it is this, and it is doubtful if it is *bona fide*. So far as we are aware no capitalists of importance are connected with the scheme.

Springfield, Sedalia, Marshall & Northern.—Wm. Walker, of Marshall, Mo., an official of this road, is quoted as speaking as follows in regard to the progress of work:

The country which the surveyors have just traversed is very rough, and to this fact is due the slow progress they have made. The worst is over, however, and the remainder will be easy. I do not expect the surveying corps to reach Sedalia until Aug. 9, and it will be two months later before Miami is reached. This includes a complete survey, and as the line is being located as they go along it will not have to be gone over again. Immediately upon the completion of the survey the right of way will be secured and the active work of construction begun. We expect to have cars running over the entire line inside of a year from now. The road will be about 200 miles in length. When the original line is in operation the northern line will be extended to Chillicothe.

ROCKY MT. AND PACIFIC.—Existing Roads.

Northern Pacific.—About 400 men are now at work on the line from Chehalis to South Bend, Wash. The right of way is cleared to the timber beyond Mauerman's Prairie, 18 miles from Chehalis, and 17 miles of grading is finished. Track has been laid from Chehalis to the third crossing of the Chehalis River, 8 miles.

Portage.—Supt. G. J. Farley, of the Portage Railroad, to be operated by the State of Oregon at the Cascades locks, is quoted as saying that the work is progressing rapidly. He has purchased a locomotive for the road and 12 flat and 4 box cars. It is intended to have the road and boats in readiness to move this season's wheat crop.

Snohomish, Skyhomish & Spokane.—The contract for building this railway from Port Gardner to Snohomish, 10 miles, has been let to King & Dickinson, of Tacoma, Wash. A force will be put at work at once and the road completed as soon as possible.

Projects and Surveys.

Port Angeles Southern.—The bonus of $350,000 in aid of this road has been raised, and contracts will probably soon be let for building the section from Port Angeles to Junction City, 35 miles.

Salt Lake, Colorado and Gulf.—J. H. Hanna, one of the incorporators of this company, in speaking of this enterprise said:

Four hundred thousand dollars have already been subscribed, which will be used to build 55 miles of the road from Fort Wingate, New Mex. Then bonds will be floated and the work pushed until 615 miles are completed. About 210 miles of the road have already been surveyed and work will be commenced in October. In the Montezuma Valley we have sufficient coal, fruits, timber and sandstone to insure a good local traffic, and 1,000 tons of coal per day have been contracted for by parties on the coast. The line will tap Farmington, Cortez and the Navajo reservation, and the prospects are very bright. When completed, the line will shorten the distance from Denver to Los Angeles 300 miles and 200 miles between Denver and Galveston.

FOREIGN.

Mexican Western.—The *Mexican Financier* says:

This line will, with the main line from Topolobampo Bay to Ciudad Portirio Diaz (Piedras Negras), the 310 miles of branches projected here, and the extension through Texas to Galveston, have, in all, 1,410 miles. The Credit Foncier Co. has taken the contract to survey and construct the roadbed, lay the rails, build the bridges, erect the buildings, water-tanks, etc., and operate the line, receiving in payment for the labor performed certificates of stock and bonds of the railroad company. A syndicate of capitalists have agreed to furnish the money to buy the materials to build and equip the road, and the money is now in bank necessary for the first 15 miles; the balance is pledged to be forthcoming as needed. When completed the Credit Foncier Co. will own three-fifths or more of the property.

CITY TRANSIT.

Electric Railways.—New lines or extensions of existing systems are reported as probable in the following places: Chattanooga, Tenn.; Santa Monica, Cal., address J. A. Stanwood; Minneapolis, Minn., address T. B. Walker; Oakdale, Mass.; Albany, N. Y., address the Albany Ry. Co.; Logansport, Ind., address the Logansport Ry. Co.; Painesville, O.; College Springs, Neb.; Auburn, N. Y.; Kilbuck, N. Y.; Paterson, N. J., address the Paterson Ry. Co.; Martinsville, Ind., address the Martinsville Rapid Transit Co.; Yankton, S. D., address W. J. Kountz; Port Carbon, Pa.; Alameda, Cal., address Theodore Meetz; Foxboro, Mass.

Newton, Mass.—The Garden City Street Ry. Co. has received permission to build a single track line about three miles long. Storage batteries will furnish power. The track must be laid and cars running within six months.

Jersey City, N. J.—It is reported that the Plank Road Co. controlled by the Pennsylvania R. R. Co. will build a line between Newark and Jersey City.

Wilkes Barre, Pa.—The new electric railway syndicate is reported to have adopted the Short system for use on its lines.

Middletown, Del.—A company is being formed to build a line to Odessa, 4 miles distant.

Jeffersonville, Va.—It is reported that Andrew Pizzini, of Richmond, will adopt electricity on his line from Jeffersonville to Tazewell C. H.

Atlanta, Ga.—The Atlanta, West End & McPherson Barracks Ry. Co. will buy two 110-HP. generators.

Columbus, Ga.—J. E. Lynch, of New York, has been awarded a contract to construct a line 3½ miles long for the North Highlands Co.

Indianapolis, Ind.—G. B. Kerper and others, of Cincinnati, O., are interested in carrying out the plans of the old Broad Ripple Co., which recently suspended work owing to trouble with the Edison General Electric Co.

Elgin, Ill.—A railway from Elgin to Aurora, passing through St. Charles, Geneva and Batavia, is reported to be projected by street railway men in Elgin and Aurora.

Denver, Col.—The Metropolitan Co., a branch of the Tramway Co., has obtained a franchise for an electric road over a large number of streets. Probably 13 miles of track will be completed this year and about $500,000 expended in improvements, according to the *Electrical Engineer*.

Haywards, Cal.—Felix Chappellett, W. E. Ames, H. B. Miller, V. W. Gaskill and H. de Laguna have petitioned the Alameda County Board of Supervisors for a franchise for a line from Haywards to San José.

Horse Railways.—New lines or extensions of existing systems are reported as probable in the following places: Philadelphia, Pa., address the Hestonville, Mantua & Fairmount Passenger Ry. Co.; Pawtucket, R. I., address Pawtucket Street Ry. Co.; Harrisburg, Va., address S. B. Loeb; St. Johnsbury, Vt.; Corpus Christi, Tex., address the Gussett Street Ry. Co.

Alexandria, Va.—It is reported that a company is being formed to build a road from Rosslyn to the Arlington cemetery, the cars to be bought of the Washington & Georgetown R. R. Co., which is putting in a cable plant.

New Orleans, La.—The right of way for street railways over certain streets for 25 years will be sold at auction Sept. 21.

Lake Charles, La.—All the stock of the Lake Charles Street R. R. Co. has been taken, and the surveys were recently completed by the parish surveyor.

Springwells, Mich.—The Township Board has granted permission to the Detroit Suburban Ry. Co. to lay tracks on several streets.

Dummy Railways.—*Buford, Ga.*—A local newspaper states that a line to Cumming is proposed. The estimated cost is $80,000, and a company of capitalists is said to have agreed to complete the line if the residents will raise $40,000.

Montgomery, Ala.—Dr. S. D. Seely has received permission from the City Council to build and operate a line in the western part of the city.

Cable Railways.—*Chicago, Ill.*—It is reported that the Chicago City Ry. Co. will extend its cable system south from 63d to 82d St., over the route of the present horsecar line.

New Companies.—Northwestern Street Car Co., Chicago, Ill.; capital stock, $100,000; incorporators, C. Seegers, F. Wilke, W. Houssen. Roxborough R. R. Co., Roxborough, Pa.; capital stock, $100,000; incorporators, W. F. Dixon and others. Chicago & Evanston Electric Ry. Co., Chicago, Ill.; capital stock, $500,000; incorporators, J. L. Cochran, D. L. Louderbach, F. S. Gorton, A. Clark. International Electric Ry. Co., Chicago, Ill.; capital stock, $2,500,000; incorporators, D. L. Coe, M. M. Wood.

HIGHWAYS.

New York.—Engineer McLaughlin has submitted to the Queens County Supervisors estimates of cost of building the macadam Jericho turnpike. The estimate is $262,000.

Pennsylvania.—The Orvilla Avenue Turnpike Co. will apply for a charter Aug. 17 for a short turnpike in Hatfield township.

West Virginia.—In Logan County the court has ordered surveys for 40 to 50 miles of roads. W. D. Sell, of Logan, is Engineer.

Indiana.—The Eagle Hollow and Manville Turnpike & Gravel Road Co. has been incorporated to construct and maintain a macadamized and graveled road from Madison township to Milton township; capital stock, $12,500.

Crested Butte, Col.—Harry Wright has been ordered to make a preliminary survey for a wagon road to marble quarries.

California.—There is talk of building a macadamized road 80 ft. wide from Los Angeles to Santa Monica.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Holyoke, Mass.*—The following proposals were received by the Commissioners of Hampden Co., Mass., July 14, 1891, for building the superstructure of a bridge over the Connecticut River, between Holyoke and Chicopee, Mass., in accordance with plans and specifications by Edward S. Shaw, Consulting Engineer, of Boston.

The bids were upon the following items: No. 1 A—Wrought iron in structural parts of bridge, per lb., 1,503,000 lbs. No. 1 B—An alternative of steel for certain members and parts, per lb., 1,322,000 lbs. No. 2—Wooden flooring, per lin. ft., 800 lin. ft. No. 3 A—Sidewalk railings, per lin. ft., 1,600 lin. ft. No. 3 B—Alternative railing, per in. ft., 1,600 lin. ft.

The contract was awarded by the Commissioners to R. F. Hawkins, of Springfield, on the basis of bids for Item No. 1 B, Item No. 2, and Item No. 3 B.

Name.	Item No. 1 A. Cts. per lb.	Item No. 1 B. Cts. per lb.	Item No. 2. $ per lin. ft.	Item No. 3 A. $ per lin. ft.	Item No. 3 B. $ per lin. ft.	Totals. No. 1 A. No. 2 and No. 3 A.	Totals. No. 1 A. No. 2 and No. 3 B.	Totals. No. 1 B. No. 2 and No. 3 A.	Totals. No. 1 B. No. 2 and No. 3 B.
Berlin Bridge Co., East Berlin, Conn.	3.685	3.825	9.19	1.35	1.75	$64,897	$65,537	$60,077	$60,717
R. F. Hawkins' Iron Works, Springfield, Mass.	3.74	3.81	10.50	1.00	1.35	66,212	66,772	60,367	60,927
Penn Bridge Co., New York, N. Y.	3.89	3.89	8.70	1.49	2.09	67,811	68,771	60,768	61,728
Rochester Bridge Works, Rochester, N. Y.	3.88	3.97	9.25	1.60	1.92	68,276	68,788	62,442	62,954
Vermont Construction Co., St. Albans, Vt.	4.00	4.10	10.25	1.00	1.25	69,920	70,320	64,002	64,402
Boston Bridge Works, Boston, Mass.	3.74	3.82	13 95	1.90	2.70	70,412	71,692	64,699	65,979
Pencoyd Bridge & Construction Co., Philadelphia, Pa.	3.90	4.04	12.00	2.25	2.50	71,817	72,217	66,608	67,008
Cofrode and Saylor, Pottstown, Pa.	3.98	4.18	11 65	1.65	2.30	71,779	72,819	67,218	68,258
Springfield Iron Works, Springfield, Mass.	4.15	4 25	11.25	1.60	2.25	73,934	74,974	67,745	68,785
The King Iron Bridge Co., Cleveland, O.	4.35	4.45	8.64	1.35	1.80	74,452	75,172	67,899	68,619
Keystone Bridge Co., Pittsburg, Pa.	4.213	4.377	10.60	1.50	2.00	73,721	74,921	68,263	69,063
Hilton Bridge Construction Co., Albany, N. Y.	4.00	4.35	10.25	1.60	2.25	70,880	71,920	68,267	69,307
Pittsburgh Bridge Co., Pittsburg, Pa.	4.19	4.29	12.00	1.35	1.80	74,736	75,456	68,473	69,193
Youngstown Bridge Co., Youngstown, O.	4.22	4.34	11.00	2.25	2.75	75,827	76,627	69,775	70,575
New Jersey Steel & Iron Co., Trenton, N. J.	4.50	4.64	9.34	1.49	2.11	77,491	78,483	71,196	72,188
Passaic Rolling Mill Co., Paterson, N. J.	4.16	4.32	17.25	2.00	2.75	79,525	80,725	74,109	75,309
Groton Bridge Co., Groton, N. Y.	4.60	4.80	10.00	2.00	2.50	80,338	81,138	74,655	75,455
The Massillon Bridge Co., Massillon, O.	4.68	4.92	10.50	1.31	1.90	80,836	81,780	75,537	76,481
Dean and Westbrook, New York, N. Y.	4.69	4.70	17.98	1.50	1.75	87,275	87,675	78,918	79,318
W. H. Shepard & Sons, Havana, N. Y.	5.125	5.375	10.00	2.00	2.30	88,229	88,709	82,257	82,737

Farmington, Me.—An iron bridge to cost $8,000 will be built across Sandy River at this place.

Cohoes, N. Y.—Bids will be received until July 27 for building an iron viaduct connecting Garner and Division Sts.

WATER-WORKS.

NEW ENGLAND.

Madison, Me.—Works are projected.

Concord, N. H.—The Water Commissioners have adopted plans for a high-service system to be built at once. There will be a pumping station, reservoir, with a capacity of 2,000,000 galls. or more, a 20-in. force main and a 14 and 12-in. supply main. V. C. Hastings is Superintendent.

Exeter, N. H.—There is talk, merely, of the town buying the company's works.

Springfield, Vt.—A reservoir company has been formed and dam will be built, probably for water-power purposes

South Hadley Falls, Mass.—A report on an increased water supply has been made by Engineer Strong, of Northampton. A new 5,000,000-gall. storage reservoir above the present one, or a reservoir on Leaping Well Brook, with a 10-in. supply main, were discussed. Estimated cost of latter, $27,500. The matter will be discussed at a meeting July 27.

Wallingford, Conn.—Bids for furnishing new mains were about $27,000 for cast-iron and $23,745 for wrought-iron and cement pipe.

MIDDLE.

Albany, N. Y.—A committee from the Business Men's Association has reported in favor of a new supply from Sand Lake, instead of from the Normanskill, as proposed.

Brooklyn, N. Y.—The Aldermen have authorized the issuance of $150,000 of water-main extension bonds and the expenditure of $25,000 for cleaning the Ridgewood reservoir.

Cattaraugus, N. Y.—The following is from L. H. Northrup, Secretary:

The Cold Spring Water Co. has the village contract for fire protection, and expects to complete works by Dec. 1. Supply, springs, by gravity. Estimated cost, $12,000 to $15,000. E. L. Johnson is President.

Clyde, N. Y.—A suction pipe is being laid from the pumps to the river for a new supply. It is reported that a new filter will be added. E. M. Bassett, of Buffalo, is Secretary of the company.

Dryden, N. Y.—Works are projected.

Edwards, N. Y.—P. L. Doyle, of Hermon, informs us that there is talk of works here.

Hancock, N. Y.—It is reported that the works have changed hands, and will be improved.

Lancaster, N. Y.—D. L. Ransom, Village President, informs us that works are under consideration, but no definite action has yet been taken. Population, about 2,000.

Lawrence, N. Y.—W. H. Widger informs us that works are projected by the Lawrence Water Co.; estimated cost, $8,000. The supply would be from a pond, and a main 1½ miles long would be sufficient to extend from the pond to and through the village. Population, 350.

Lowville, N. Y.—A gravity supply from a point about 2½ miles distant is projected; estimated cost, $65,000. E. C. Cook, Engineer for Moffett, Hodgkins & Clarke, Syracuse, is looking over the ground.

Mayville, N. Y.—On Aug. 1 the electors will vote on the levying of taxes to pay for a water supply.

Rochester, N. Y.—Bids for trenching and pipe-laying on several streets are wanted until July 24. T. J. Neville is Clerk of the Executive Board.

Sandy Creek, N. Y.—Works are under construction. D. E. Ainsworth is interested.

SOUTHERN.

Fell Township, Lackawanna Co., Pa.—The Panther Creek Water Co. was incorporated July 21 with an authorized capital of $20,000 and $1,000 paid in. Thomas H. Waters, Scranton, is President, and the principal place of business is at Scranton.

Graham, Va.—The following is from Walter Graham, Engineer:

A franchise has been secured and preliminary estimates for works made, the supply to be by gravity from springs on East River Mountain. Cost, $30,000. Population, 2,000.

Oxford, N. C.—Works are again projected.

Atlanta, Ga.—The Council has approved the contract for three 16,000,000-gall. Gaskill pumps, voted last week.

Barnesville, Ga.—Address J. J. Rogers regarding proposed works.

Carrollton, Ga.—Henry Lanier informs us that the city is still open to offers for a franchise.

Cedartown, Ga.—It is reported that two 1,000,000-gall. pumps and a 16 × 80-ft stand-pipe will be wanted by the city. Address A. Richardson.

Macon, Ga.—A bill has been proposed for presentation to the legislature authorizing the city to issue $412,000 of bonds for works.

Savannah, Ga.—The Water Committee of the Council has awarded the contract for two 10,000,000-gall. pumps and for 6 boilers to the Holly Manufacturing Co., the price being $39,000 and $10,000, respectively.

Wrightsville, Ga.—Works have been voted. The supply will be from an artesian well already sunk.

Columbia, Ala.—W. W. Saunders, Mayor, has sent the following:

A contract for works may be let in September. The city has authority to issue bonds, but may grant a franchise. An artesian well, with a small flow, has been sunk. Cost, $5,000 to $7,500. Population, 1,750.

Dothen, Ala.—W. Pitcher, City Clerk, informs us that bonds for works have been voted, but no definite steps toward construction have been taken. Water will probably be pumped from springs or an artesian well to a tank.

Uniontown, Ala.—J. A. Hudson, City Clerk, has sent the following:

Contracts for works will be let as soon as $25,000 of 6% bonds have been sold. An artesian well has been sunk, from which water will be pumped to a stand-pipe. Population, 1,200.

Shelbyville, Tenn.—It is reported that J. E. Thompson, Murfreesboro, has the contract for works here.

NORTH CENTRAL.

Bellaire, O.—Bids for improvements to the pumping machinery will be received until Aug. 1. H. G. Wilson is Secretary.

Wapakoneta, O.—J. B. Walsh, City Engineer, informs us that the people have voted for works. Population, 3,600. Press items state that it is optional with the Council to build works or grant a franchise.

Cannelton, Ind.—It is reported that construction of water-works and electric lighting plants has been started.

Brookville, Ind.—T. H. Brown has sent the following:

Proposals for building works to be owned by the town were received July 23. Water will be pumped from a well to a tank. Cost, $21,000. Address J. Butler or J. Burkhard. Population, 2,300.

Napp nee, Ind.—The following is from P. A. Early:

The town will let a contract for building works about Aug. 20. Water will be pumped from tubular wells to a stand-pipe. Cost, $10,00 to $12,000. Population, 1,600.

Buchanan, Mich.—F. A. Treat, Village Clerk, informs us that the water-works election was postponed from July 17 to July 22.

Chicago, Ill.—The Waukesha Hygeia Mineral Co. has been incorporated to lay a pipe line from Waukesha, Wis., to Chicago, to convey mineral water to the Columbian Exposition and to another station in the city; capital, $2,000,000; incorporators, A. E. Wagner, F. C. Prest and others. The necessary rights have been secured from Waukesha, and an application has been made to the Chicago Council.

Dwight, Ill.—It is reported that the Council has decided to build $20,000 works.

Peru, Ill.—The incorporation of the Peru Water Works Co. is reported; capital stock, $20,000; incorporators, Wm. Holly, G. D. Ladd, Henry Bellinghausen and others. It is also reported that the Peru Artesian Water Supply Co. has authority to increase its capital stock.

Pontiac, Ill.—W. McKay, Mayor, informs us that J. J. Hainsworth, Peru, has the recently granted franchise.

Shelbyville, Ill.—The Shelbyville Water & Light Co., of New York City, has been incorporated to operate electric light, power and gas plants and water-works; capital stock, $50,000.

Marshfield, Wis.—Bids for new works have just been received; a supply from springs a mile west of the city is proposed.

Estherville, Ia.—A. O. Peterson, Mayor, informs us that a franchise previously granted was not accepted, and is now open to others. The franchise is exclusive for 20 years, and provides for not less than 1½ miles of mains and 10 hydrants, the latter at an annual rental of $60 each. Exemption from taxation for 7 years is granted. Pumping would be used.

Lyons, Ia.—A controlling interest in the Lyons Water-Works Co. has been secured by the American Water-Works & Guarantee Co., Pittsburg, Pa. The latter company controls the works at Clinton, and the two systems will be connected.

Northfield, Minn.—A report submitted to the Council estimates the cost of works, including pumping machinery and stand-pipe, at from $32,000 to $37,000. No action was taken.

Winnebago City, Minn.—J. H. Welch informs us that the city expects to let contracts soon for works. Cost, $10,000; supply, deep well, pumping to reservoir. Population, 1,500.

Parsons, Kan.—The granting of a franchise to a second company is talked of.

Chadron, Neb.—D. J. Mears informs us that $20,000 of bonds have been voted to lay 4 miles of mains.

Butte, Mont.—The Council has voted to ask for bids for supplying water for five years, owing to the failure of the Butte City Water-Works Co. to take satisfactory steps toward construction of works.

SOUTHWESTERN

Brunswick, Mo.—L. Benecke, President Brunswick Water Co., has sent the following:

A flowing well has been secured, and estimates for constructing works are wanted, as definite action will be taken this fall.

Kansas City, Mo.—G. W. Pearsons, Superintendent of Construction, informs us that the Board of Public Works has invited G. H. Benzenberg, Milwaukee; Charles Hermany, Louisville, and M. L. Holman to consider the questions involved in connection with the proposed purchase of the present works and construction of supply works in Missouri. Mr. Pearsons has done the preliminary work.

Westport, Mo.—The Council thinks of contracting with the National Water-Works Co., Kansas City, for an extension of its works.

Texarkana, Ark.—It is reported that works with a supply from artesian wells are projected. Company works are now in operation.

Ballinger, Tex.—B. M. Burks, Mayor, informs us that a contract for works will be let Aug 3. The population is about 2,000.

Belton, Tex.—The Belton Water Co. has been incorporated with J. Z. Miller, Jr., H. C. Denny and others as directors; capital stock, $30,000. The present works are owned by the city and operated by the Belton Light & Water Co.

Comanche, Tex.—A. L. Hemper informs us that a company has applied for a franchise, but the town prefers to build works. Proposed supply, wells, pumping to stand-pipe. Estimated cost, $30,000. Population, 2,000.

Fort Worth, Tex.—It is probable that bids for building the new works will soon be asked. Offers looking to private ownership have been rejected.

Guthrie, Ok. T.—The City Clerk informs us that contracts for works to be owned by the city will be let Aug 15. Address G. W. Taylor, Chief Fire Department. Estimated population, 8,000.

Durango, Col.—Bids will be received until Aug. 4 for furnishing 2,500 ft. of 8-in. cast-iron pipe. Blair Burwell, City Clerk.

Erie, Col.—Bids will be received by the Town Council until Aug. 1 for the construction of works. William Knowles is Town Clerk.

PACIFIC.

Spokane, Wash.—Bids are asked until Sept. 15 for $500,000 of water bonds.

Tacoma, Wash.—According to a *Ledger* interview with C. B. Hurley, Superintendent of the Tacoma Light and Water Co., the following improvements will be made:

A gravity conduit 48 ins., or less, in diameter will be laid from Clear Creek to a new pumping station in or near the city. Distributing mains will be laid in various parts of the city. The estimated cost of the new work is $400,000.

Dallas, Ore.—M. M. Ellis, Mayor, informs us that a franchise was, at time of writing, being granted for gravity works to cost about $57,000.

Berkeley, Cal.—The Berkeley & Lorin Water & Light Co. has been incorporated at San Francisco, to deal in water, water rights, light and power; capital stock, $250,000; directors, W. L. Sheldon, W. F. Martin and others.

Gilroy, Cal.—It is reported that the $50,000 recently voted will be spent for a 5-mile main to a reservoir and a 3-mile main from the reservoir to the city.

Francis, Cal.—It is reported that works are being built, including a pump and a 100,000-gall. reservoir.

CANADA.

Kingsville, Ont.—It is reported that works are to be built.

ARTESIAN WELLS.

Leavenworth, Ind.—A contract has been let by the Town Board for three wells on a hill for water-works

Niobrara, Neb.—An election will be held Aug. 20 to vote $3,600 of bonds to aid in sinking a well.

Texas.—Wells are projected at Childress, Lyons and Milford. At the first place $2,650 have been subscribed, and at the second $1,000.

IRRIGATION.

Nebraska.—The Omaha *Bee* states that a company with a capital of $5,000,000 is being organized to operate in the valley of the Stinkingwater River. The irrigation of 500,000 acres is talked of.

Sheridan, Wyo.—The *Enterprise* has the following regarding a project in northern Wyoming:

H. N. Robinson, Jr., with two assistants, will go into the mountains immediately, to make surveys for a ditch out of the Tongue River west of Black's Peak, around the base of the peak through a low pass, across Little Tongue River, over the divide and across Wolf Creek, again over the divide into Soldier Creek, and from there onto the plateau northwest of town.

La Junta, Col.—Bids will be received until July 31 by Engineer J. H. Nelson for constructing the Colorado Irrigation Canal from the Arkansas River, in eastern Colorado, to a point in Kansas, near the line. Bonds to the amount of $150,000 will be required from the successful bidder.

Albuquerque, N. M.—Engineers of the Denver & Rio Grande Ry. Co. will make surveys for a canal from this place to Santa Cruz Cañon, where a dam is to be built.

Santa Fe, N. M.—The Santa Fe Irrigation Co. has been incorporated and has been granted the right to take water from the Santa Fe River below existing ditches. The incorporators are L. A. Hughes, J. W. Akers and others. Capital, $175,000. The engineer's report states that the

company proposes to construct an 8-mile canal and two storage reservoirs, about 5 miles south of the city, with a combined capacity of 636,000,000 cu. ft. About 18,000 acres near the city are to be irrigated.

New Companies.—Upland Reservoir Co., Larimer Co., Col.; $5,000. A. L. Johnson, John Lamb, F. C. Avery, Beaver Ditch Co., Carbon Co., Utah: $10,000; to take water from Big Beaver Creek. Moab Irrigation Co., Grand Co., Utah: $39,000. Dry Dock Creek Reservoir and Irrigation Co., Salt Lake City, Utah; $60,000. Willow Creek Irrigation & Water Co., Ashland, Ore.; $5,000. W B. Ewing and others.

SEWERAGE AND MUNICIPAL.

Sewers.—*Massachusetts.*—Beverly. The Sewer Committee will hold a meeting July 29 to examine the plans of Ernest Bowditch. C. H. Odell and E. L. Giddings are on the committee.—Cambridge. The Committee on Sewers has been authorized to ask bids for 500,000 sewer brick, to be delivered within a year.—Clinton. The Town Treasurer has been authorized to borrow $10,000 for sewer construction.—Marlboro. The Council has ordered the issuance of $100,000 of sewerage bonds.—Palmer. J. J. Van walkenburg has completed plans for sewers.—Watertown. The Sewer Committee, H. H. Sawyer, Chairman, has been authorized to contract for sewers, and $100,000 4½% bonds have been voted. Satisfactory bids for labor have been received, but those for material were not so. Connection will be made with the Charles River Valley Metropolitan Sewer.—West Springfield. An appropriation of $8,000 for sewers has been made.

Rhode Island.—Pawtucket. Appropriations have been made for sewers in several streets.

New York.—Greenwich. Plans for a system have been made by the Troy Engineering Co.—Hornellsville. S. F. Willetts is President and C. R. Westcott Secretary of the Sewer Commission.—Lansingburgh. An election will be held to decide on the building of sewers in several streets at an estimated cost of $70,000.—Sandy Hill. Plans for a system have been made by Smith Reeves, of Troy.—Troy. A 26⅝ × 40-in. brick sewer will be built under direction of the Public Improvement Commission.

New Jersey.—Summit. Plans for a system have been submitted to the Township Committee.

Pennsylvania.—Wilkinsburg and Brushton. A survey will be made for a trunk sewer down the valley to the Monongahela River.

Georgia.—Brunswick. J. F. Beach, W. E. Kay and W. E. Burbage have been inspecting the West system. A company will be organized to ask for a franchise.

Tennessee.—Knoxville. The sum of $250,000 has been voted for sewers.

Kentucky.—Lexington. A trunk sewer on Vine St. is under consideration.

Ohio.—Columbus. The Council has appropriated $250,000 for sewers.—Haselton. It is reported that a system will be built.

Michigan.—Ypsilanti. Sewers are under consideration.

Iowa.—Des Moines. Sewers will be put in North Des Moines, Capital Park and University Place.

Kansas.—Topeka. It is reported that $90,000 will be spent for sewers.

North Dakota.—Grand Forks. Bids for constructing a system will soon be asked. The plans have been approved by C. B. Davis, Chicago.

Missouri.—St. Louis. Sewers will soon be built in several streets.

Washington.—Puyallup. A vote on $45,000 of sewer bonds will be taken July 28.

California.—Sausalito. A system is projected by the Improvement Association.—Santa Monica. Sewers are projected.—Ukiah. Bonds to the amount of $25,000 are proposed for acquiring and building sewers.

Streets.—*New York.*—Buffalo. Asphalt paving will be put down. Troy. A part of Third St. will be paved with asphalt and a part with granite blocks. A part of Spring Ave. will be graded.

Pennsylvania.—Scranton. The Council has ordered the Public Square paved with sheet asphalt.

Tennessee.—Knoxville. A vote has been cast in favor of spending $125,000 for paving.

Illinois.—Lyons. The macadamizing of all the streets not so treated last year will be carried out.

ELECTRICAL.

Electric Light.—New plants or extensions of those already existing are reported as probable in the following places: Ellicott City, Md.; Leroy, Fla.; East Aurora, N. Y.; Peoria, Ill., address the Jenny Electric Light & Power Co.; Pass Christian, Miss., address Shaffer Bros.; Baltimore, Md., address J. Pope; Bellows Falls, Vt.; Dallas, Tex.; Flemingsburg, Ky., address the Flemingsburg Electric Light Co.; Corpus Christi, Tex.; Galion, O.; Schoolcraft, Mich., address P. D. Miller; Edinburg, Ind.; Crown Point, Ind.; Cambria, Wis.; Port Republic, N. J., Marion, Ill.; Gallipolis, O.

Spencer, Mass.—The residents are discussing the installation of a municipal gas and electric lighting plant.

High Point, N. C.—E. A. Snow and J. E. Cox have been appointed by the City Council to act as a committee to buy a plant of about 50 arc lights capacity.

Charleston, S. C.—The Charleston Light & Power Co., will receive proposals for the construction of the foundations and buildings of its new station.

Quincy, Ill.—Proposals for public lighting for the ensuing year will be received until July 30 by C. H. Gillespie.

Springfield, Ill.—The City Council has granted to Laban Sparks, J. W. Jefferson and their associates permission to operate a plant under the name of the Citizens' Light & Power Co. The company agrees to furnish the city with 2,000 c. p. arc lights at $75 per annum, each on a 10-year contract. The rates to private parties for 2,000 c. p. lights are: Until 9 P. M., $5 per month; until midnight, $6.25; all night, $8. Incandescent lights of 10 c. p., 55 cts. per month burning until midnight; 80 cts. per month burning all night.

Kansas City, Kan.—The recently incorporated Merchants' Electric Light Co. proposes to erect a plant with a capacity of 100 arc and 500 to 600 incandescent lamps.

Hallettsville, Tex.—Mayor M. S. Townsend wants bids for furnishing a plant of 300 incandescent lamps capacity working over a 4-mile circuit, also for a system of 10 arc and 200 incandescent lights on a 2-mile circuit.

New Companies.—Eureka Electric Co., Chicago, Ill.; capital stock, $10,000; incorporators, L. K. Curlett, C. W. Fletcher, C. F. Gooding. Merchants' Electric Light Co., Kansas City, Kan.; capital stock, $50,000; incorporators, C. Hoffman, H. Ettenson, H. Bruns. Illinois Electric Welding & Mfg. Co., Chicago, Ill.; capital stock, $20,000; incorporators, P. Harvey, J. W. McGeah, R. L. North, Jr. Beatrice (Neb.) Light & Power Co.; capital stock, $250,000; incorporators, E. P. and F. J. Maxwell, W. Pickrell and others. Granite Falls Power Co., Snohomish. Wash.; capital stock, $200,000; incorporators, E. Blackman, C. H. Anderson, F. M. Headlee and others. San Antonio Light & Power Co., Los Angeles, Cal.; capital stock, $240,000; incorporators, T. K. Bard, of Hueneme; N.W. Blanchard, of Santa Paula; J. A. Dale, of Pomona, and others. Edison Light & Power Co., San Francisco, Cal.; capital stock, $3,000,000; directors, F. F. Upton, J. D. Green, Gustav Sutro and others.

CONTRACTING.

Sewers.—*Albany, N. Y.*—The contract for building the 3-ft. brick and cement Cherry Hill sewer has been awarded to R. H. Strong at $3.15 per foot; $70 for manholes; $90 for receving basins.

Brick Paving.—*Cedar Rapids, Ia.*—The contract for paving several streets with brick has been awarded to Henry Bessler at $1.68 a yard.

Cable Driving Plant.—*New York and Brooklyn Bridge.*—Opened July 20.

ITEMS.	W'GHT.	R. Poole & Son Co.		Southwark Foundry & Machine Co.	
Those marked + are to be delivered only—others are to be delivered and erected.	No. Lbs.	Price.	Amt.	Price.	Am't.
		Cts.	$	Cts.	$
Main and drum shafts	12 30,300	5¼	1,661	6	1,812
+Sheave shafts	16 8,000	6¾	520	8	640
Pinion shafts	6 250	30	75	11	27
Hollow shafts, cast-iron	5 20,700	7¾	1,553	9¼	1,967
Pairs of spur gears	3 78,900	7	5,173	7	5,173
Bevel gears and pinions	4 & 6 6,300	8	520	7 8-10	507
Winding drums	4 75,400	6¼	4,901	11¾	8,871
+Deflection sheaves	34 114,200	10	11,420	9½	10,849
+Curve sheaves	60 14,700	25	3,675	10¾	1,543
+Supporting pulleys and frames	250 14,600	8	1,168	5½	803
Spiders and segments	4 & 12 8,600	12½	1,075	13 3-10	1,144
Drum and main shaft bed plates	3 & 4 70,400	4½	3,168	8¾	6,160
+Deflection sheave frames	24 30,000	5½	1,650	14¼	4,275
Joint couplings	2 3,000	6	180	11	330
16-in. pillow blocks	6 20,000	12½	2,500	12	2,400
12-in. " "	4 11,100	12½	1,387	12	1,332
11-in. " "	8 15,800	12½	1,975	12	1,896
6-in. " "	32 16,000	12	1,920	12 4-10	1,984
Tension cars	2 30,000	10	3,000	11	3,300
Totals			$47,321		$54,813
Friction clutches:		$	$	$	$
1,500 H. P.	2	2,000.00	4,000	2,100.00	4,200
1,000 " "	4	1,750.00	7,000	1,837.50	7,350
750 " "	1	1,500.00	1,500	1,575.00	1,575
+Operating gear:					
Forked levers	6	150.00	900	157.50	945
Brackets	6	35.00	210	36.75	220
Hangers	8	12.50	100	13.12	105
Cranks	8	10.00	80	10.50	84
Shafts	6	12.50	75	13.12	79
Connecting rods	7	15.00	105	15.75	110
Standards	6	250.00	1,500	262.50	1,575
Handwheels and spindles	7	50.00	350	52.50	367
Bevel pinions	6	12.50	75	13.12	79
Block gears	6	20.00	120	21.00	126
Spur gears	2	10.00	20	10.50	21
Totals			$16,035		$16,837

Steam engine, fly wheel weighing 50 tons, cylinders 38 x 48 ins., $11,195, William Wright; same, except with cylinder 40 x 48 ins., $15,950, Southwark Foundry & Machine Co. Removing steam engine from old to new position, William Wright, $990; Southwark Foundry & Machine Co., $660.

PROPOSALS OPEN.

Sewers.—*Boston, Mass.*—Section 15 in Chelsea and sections 16 and 17 in Everett of metropolitan sewerage system. H. A. Carson, 93 Lincoln St., Chief Engineer. Aug. 5.

Newark, N. J.—Sewer in Orange St., 750 ft. 15-in., 450 ft. 12-in. vitrified pipe. Street and Water Commissioners, July 28.

Norwalk, O.—Sewer on Linwood Ave. L. B. Mesnard, Acting City Engineer. Aug. 3.

Streets.—*Boston, Mass.*—Furnishing 300,000 large granite paving blocks. H. H. Carter, Superintendent of Streets. July 27.

Mount Vernon, N. Y.—Twelve-inch Telford macadam, 2,140 sq. yds.; 8-in., 12,450 sq. yds.; 4-in. macadam, 26,470 sq. yds.; stone-block paved gutters, 9,747 sq. yds.; cobble-stone do., 5,000. W. L. Milligan, Village Clerk. Aug. 4.

Paving and Sewer Bricks.—*Washington, D. C.*—Furnishing above for current fiscal year. District Commissioners. July 27.

Wing Dams.—*Augusta, Ga.*—Wing dams and shore protection in Savannah River below Augusta. O. M. Carter, U. S. Engineer's Office, Savannah. Aug. 1.

New York, N. Y.—Highway retaining walls and appurtenances at Croton dam. Aqueduct Commissioners. July 29.

Steel Rails.—*Victoria, B. C.*—Two hundred tons girder, 300 tons T rails. D. W. Higgins, Victoria, B. C. Aug. 15.

Johnstown, Pa.—Excavating 56,000 cu. yds. from banks of Conemaugh River; furnishing stone and building two river walls. 3,467 cu. yds. John Downey, City Engineer. July 31.

MANUFACTURING AND TECHNICAL.

Road Rollers.—Two 7-ton steam rollers have been delivered to the Detroit Board of Public Works by the Pioneer Iron Works, Brooklyn.

The Lidgerwood Manufacturing Co., of New York, Chicago and Boston, are enlarging their present works in Brooklyn, N. Y., and have just opened a branch house in Pittsburg, at 99 First Ave. It will be in charge of Mr. A. G. Harmes, of that city.

The Kenwood Bridge Co., of Chicago, has been awarded the contract for finishing and erecting 11 100-ft. trusses for the Joliet Tin Plate Co., replacing an old roof for the Diamond Plate Glass Co., Elwood, Ind., 263 × 60 ft., and putting a new roof on the Laclede Gas Co.'s building.

The Massillon (O.) Bridge Co. is erecting for the County Commissioners, at Huntington, a two-span plate-girder bridge, 84 and 90 ft. long, respectively. Each span has 36 ft. clear roadway and two 10-ft. clear sidewalks. The joists in the floor system are rolled beams, supported by riveted cross beams. The girders are built entirely of steel.

The Mount Vernon Bridge Co., Mount Vernon, O., has received the contract for the ironwork in the dome of the Administration Building of the World's Fair at Chicago. Amount, $55,000.

Steam Road-Rollers.—Aveling & Porter's steam road rollers have been purchased by Saratoga Springs, N. Y.; Westchester, N. Y.; Bridgeport, Conn., and Pittsburgh, Pa.

Companies.—Swett Car Wheel Co., Saco, Me., to manufacture and deal in car wheels and in metal and machinists' works of all kinds; G. W. Swett, Troy, N. Y., is President, Fred W. Swett, Treasurer; $250,000. Kennedy Valve Manufacturing Co., Coxsackie, N. Y., to manufacture and sell Kennedy valves and hydrants and all kinds of machinery; Daniel Kennedy, New York; Matthew Kennedy, Coxsackie; $150,000.

Metal Market Prices.—*Rails.*—New York: $30.75 to $31; old rails, $21.50 for iron and $17 for steel. Pittsburg: $30; old rails, $22.50 to $23 for iron and $17.50 to $18.50 for steel. Chicago: $31; old rails, $23 to $23.50 for iron and $14 to $16.50 for steel.

Track Materials.—New York: steel angle bars, 1.75 to 1.8 cts.; spikes, 2.15 to 2.25 cts.; track bolts, 2.7 to 2.8 cts. Pittsburg: splice bars, 1.8 to 1.9 cts. for iron or steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.75 cts. with square and 2.85 cts. with hexagon nuts. Chicago: splice bars, 1.8 to 1.9 cts. for iron, 2 cts. for steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.75 to 2.85 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $18. Pittsburg: $14.75 to $17. Chicago: $14.75 to $16.

Pipe.—Cast iron, $25 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 55 and 45 per cent. on black and galvanized butt-welded; 65 and 52½% on black and galvanized lap-welded. Casing, 55 per cent.

Lead.—New York: 4.4 to 4.5 cts. Chicago: 4.3 cts. St. Louis: 4.2 to 4.22½ cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.95 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 2 to 2.15 cts. for tank, 2.3 to 2.6 cts. for shell, 2.5 to 2.7 cts. for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2.05 cts.; sheared steel bridge plates, 2.1 to 2.15 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.1 cts. for tank, 2.4 cts. for shell, 2.6 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.1 to 2.2 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.15 to 2.2 cts.; sheared plates, 2.3 to 2.4 cts. for iron and 2.6 to 2.7 cts. for steel; steel plates, 2.4 to 2.6 cts. for tank, 2.85 cts. for shell, 3 to 3.25 cts. for flange; 4.5 to 5.5 cts. for firebox; boiler rivets, 4.25 cts.